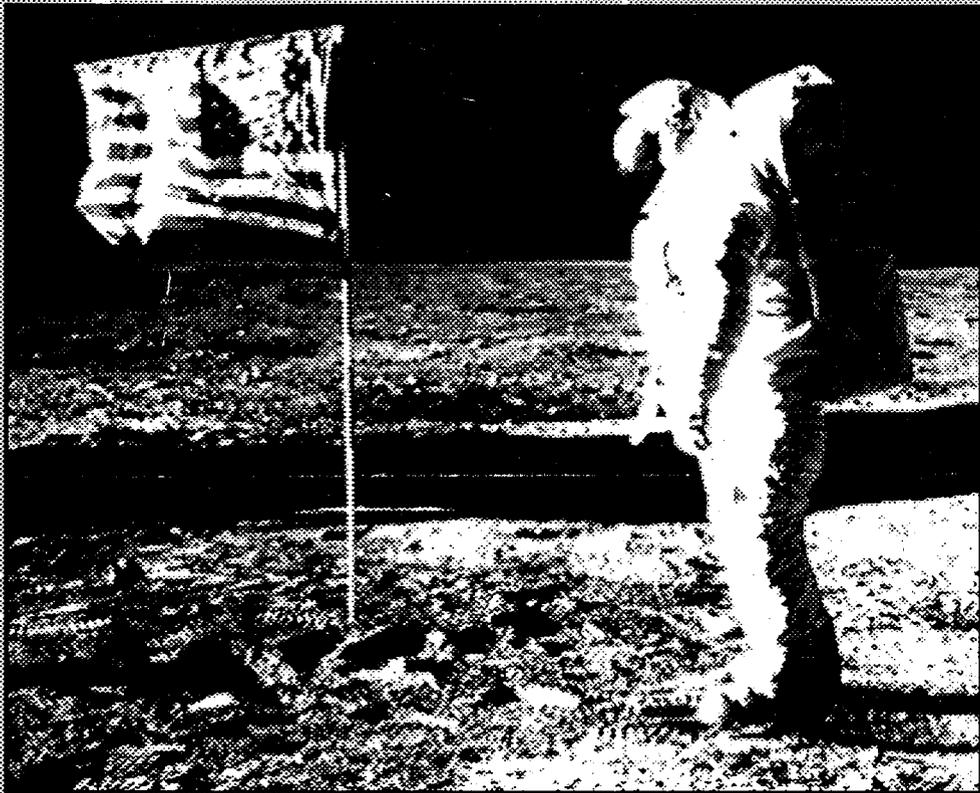


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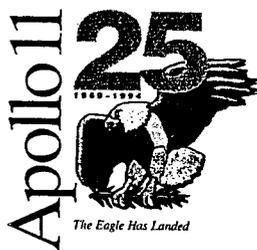
## OF THE APOLLO PROGRAM

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*OF THE*

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**APOLLO PROGRAM**

by  
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NASA History Office  
Code ICH  
NASA Headquarters  
Washington, DC 20546

**MONOGRAPHS IN AEROSPACE HISTORY**  
*Number 2*  
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## PREFACE

When future generations review the history of the twentieth century they will judge humanity's movement into space, with both machines and people, as one of its most important developments. Even at this juncture the compelling nature of space flight, and the activity that it has engendered on the part of many peoples and governments, makes the U.S. civil space program a significant area of investigation. People from all avenues of experience and levels of education share an interest in, if not always an attraction to, the drama of space flight. No doubt the lunar landing of Apollo 11 in the summer of 1969 is the high point of this continuing drama.

Although President John F. Kennedy had made a public commitment in 1961 to land an American on the Moon by the end of the decade, before this time Apollo had been all promise, and now the realization was about to begin. Its success was an enormously significant accomplishment coming at a time when American society was in crisis; if only for a few moments the world united as one to focus on the historic occasion.

Apollo 11 lifted off on July 16, 1969, and after confirmation that the hardware was working well began the three day trip to the Moon. Then, at 4:18 p.m. EST on 20 July 1969 the Lunar Module—with astronauts Neil A. Armstrong and Edwin E. Aldrin—landed on the lunar surface while Michael Collins orbited overhead in the Apollo command module. After checkout, Armstrong set foot on the surface, telling millions who saw and heard him on Earth that it was "one small step for man—one giant leap for mankind." Aldrin soon followed him out and the two plodded around the landing site in the 1/6 lunar gravity, planted an American flag but omitted claiming the land for the U.S. as had been routinely done during European exploration of the Americas, collected soil and rock samples, and set up scientific experiments. The next day they launched back to the Apollo capsule orbiting overhead and began the return trip to Earth, "splashing down" in the Pacific on July 24.

This flight rekindled the excitement felt in the early 1960s during the first Mercury space flights, and set the stage for later Apollo landing missions. An ecstatic reaction circled the globe, as everyone shared in the success of the mission. Ticker tape parades, speaking engagements, public relations events, and a world tour by the astronauts served to create good will both in the U.S. and abroad. Five more landing missions followed through December 1972, three of them using a lunar rover vehicle to travel in the vicinity of the landing site, but none of them equalled the excitement of Apollo 11.

During and since the completion of the Apollo 11 landing twenty-five years ago numerous books, studies, reports, and articles have been written about the project. This selective, annotated bibliography discusses primarily those works judged to be most essential for researchers seeking to learn more about the Apollo program's varied history. It should be noted that the word "selective" is judiciously chosen here; the works listed below do not begin to exhaust the list of those that could have been included. A complete bibliography of books and articles on lunar science alone would at least double the size of the present bibliography. It should also be noted that many of the works included below are not recommended to researchers but are included here to give them a sense of some relevant titles that they may not wish to consult. A thematic arrangement of material concerning the project will, it is hoped, bring clarity and simplicity to such a complex subject. Any such division is necessarily somewhat arbitrary, but subjects include Apollo and its precursors, the race with the Soviets, the Apollo decision, Apollo technology, operations (including coverage of specific missions and reference works dealing with lunar photography, for want of a better place to put the latter), popular culture and promotion of spaceflight, science, the astronauts, and the management of the Apollo program, with a section on juvenile literature at the end. Along with a summary of the contents of each item, judgments have been made on the quality, originality, or importance of some of these publications. An index concludes this work.

Many people assisted in producing this compilation. Lee D. Saegesser, ably assisted by William S. Skerrett and Jennifer M. Hopkins, was instrumental in obtaining many of the documents listed below, and the three of them selected the photos that appear in the bibliography and on its cover; J.D. Hunley compiled roughly half of the entries, then edited and critiqued the text; Patricia Shephard typed portions of the manuscript; the staffs of the NASA Headquarters Library and the Scientific and Technical Information Program provided expert assistance in locating bibliographical materials; Martin Manning of the United States Information Agency provided a copy of a USIA report; and the NASA Headquarters Printing and Design Center developed the layout and handled printing. Special thanks go to Dr. Joseph N. Tatarewicz who provided a great deal of information for the entries in Chapter 7 on Science.

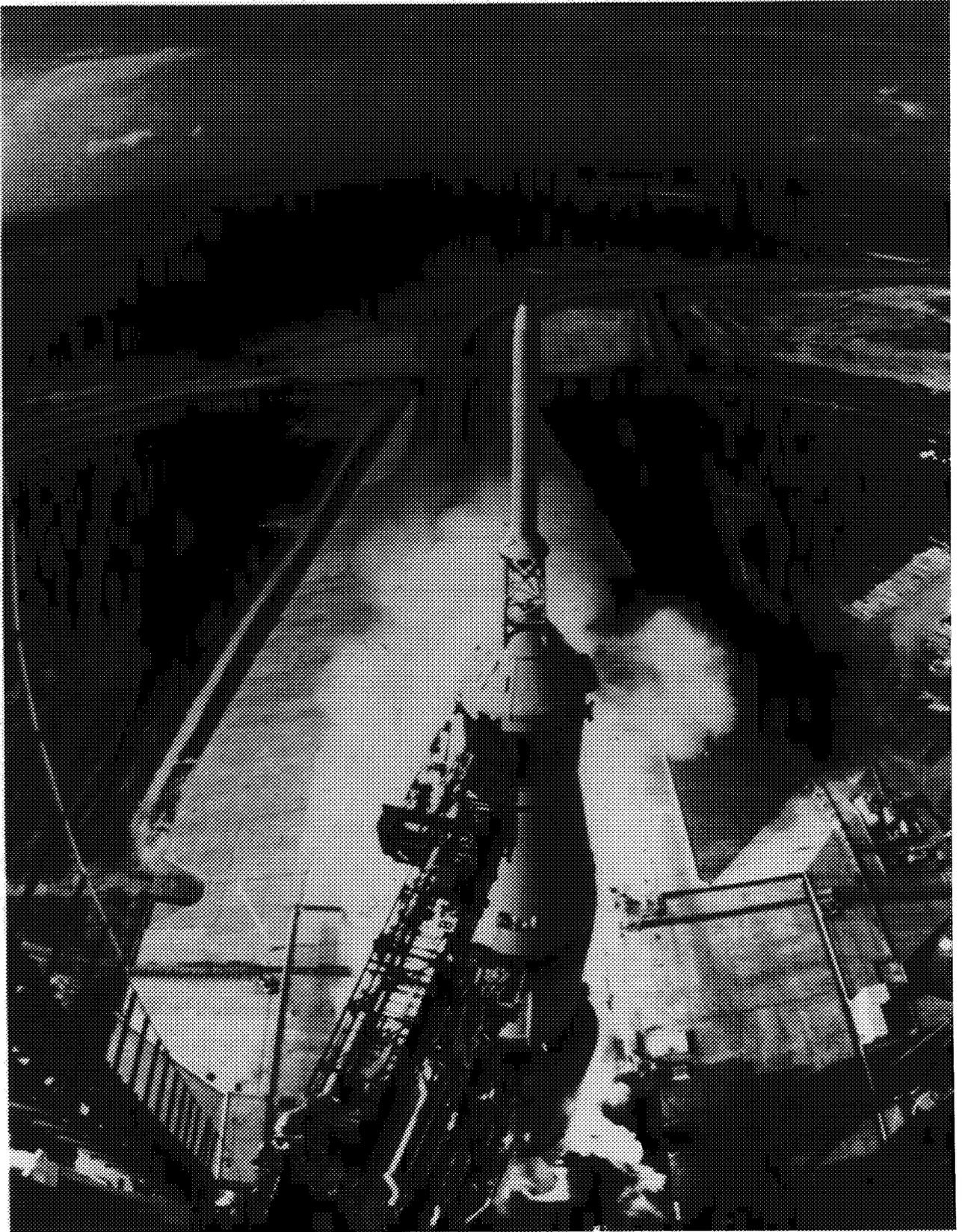
This is the second publication in a new series of special studies prepared by the NASA History Office. The MONOGRAPHS IN AEROSPACE HISTORY series is designed to provide a wide variety of studies relative to the history of aeronautics and space. This series' publications are intended to be tightly focused in terms of subject, relatively short in length, and reproduced in an inexpensive format to allow timely and broad dissemination to researchers in aerospace history. Suggestions for additional publications in the series are welcome.

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# AN ANNOTATED BIBLIOGRAPHY OF THE APOLLO PROGRAM

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*Apollo 11 space vehicle being launched aboard a Saturn V rocket at Pad 39A of Kennedy Space Center. NASA photo 69-H-1177.*

# CHAPTER 1

## GENERAL WORKS

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Alexander, T. "The Unexpected Payoff of Project Apollo." *Fortune*. 80 (July 1969): 114-117, 150, 153-154, 156. Written before the first lunar landing, this article argues that Project Apollo had already restored the damaged self-esteem of the United States, its original purpose. It had also developed techniques for managing thousands of individuals from government, universities, and the private sector to achieve a fixed goal, and it appeared to have achieved that goal for very nearly the cost projected at the outset of the project. The article goes on to discuss NASA's project management system that yielded so successful an outcome.

Anderton, David A. *Man in Space* [also entitled *America in Space/The First Decade*]. Washington, DC: NASA EP-48, 1968. This pamphlet contains information on Mercury, Gemini, and Apollo, launch vehicles, test vehicles, astronauts, pressure suits, and space medicine, but it treats each subject in overview fashion.

Andrews, John Williams. *A.D. Twenty-One Hundred: A Narrative of Space*. Boston: Branden Press, 1969. This is an epic poem of Project Apollo. It contains a foreword by Walter Cronkite who concluded that Williams had turned the space "experience into meaningful felt reality, as Housman made us feel springtime in Shropshire, or Frost, wintertime in Vermont."

*Apollo in its Historical Context*. Washington, DC: The George Washington University Space Policy Institute, 1990. See under Logsdon, John M.

"Apollo Midstream." *Astronautics and Aeronautics*. 3 (April 1965): 26-80. Features include: Joseph F. Shea, "The Approach to Apollo," 26-29; Roy F. Brissenden, "LEM Docking in Lunar Orbit," pp. 30-32; Dale D. Myers, "Apollo Spacecraft—on the Mark," pp. 38-45; Jack G. Gavin, Jr., "LEM Design Evolution," pp. 46-51; Owen G. Morris, "Apollo Reliability Analysis," pp. 52-59; Max Faget, "Apollo—The Long View," pp. 60-63; William E. Stoney, Jr., "The Designer Faces Up to Long Mission," pp. 64-69; Willard F. Libby, "Science and Manned Spacecraft," pp. 70-75; and Dean N. Morris, "Third Manned Space Flight Meeting," pp. 76-80.

Ashworth, William B. *The Face of the Moon: Galileo to Apollo, an Exhibition of Rare Books and Maps, October 13, 1989-February 28, 1990*. Kansas City, MO: Linda Hall Library, 1989. This exhibition catalog shows "how the face of the moon has been variously delineated [over the centuries] as telescopes improved, new inventions such as photography were applied, and ultimately, as space travel led humankind to the very surface of the moon."

Benedict, Howard; Morse, Ralph; and Glenn, Christopher. "Full-Court Press: Apollo Meets the Media." *Air and Space/Smithsonian*. 4 (June/July 1989): 82-89. Three members of the media who covered Apollo and earlier space and missile efforts discuss their recollections of the American space efforts in the late 1950s and the 1960s.

Benson, Charles D. and Faherty, William Barnaby. *Moonport: A History of Apollo Launch Facilities and Operations*. Washington, DC: National Aeronautics and Space Administration SP-4204, 1978. An excellent history of the design and construction of the lunar launch facilities at Kennedy Space Center. Of *Moonport*, a reviewer in the *Journal of American History* said in 1979, "The authors had access to official documents, letters, and memoranda, and they have apparently consulted all the relevant historical, technological, and scientific secondary materials...all the involved historians obviously spent considerable time studying and intellectually digesting technical reports and manuals in order to give their lay readers

such lucid accounts of highly complex procedures and operations...it is important to public knowledge to have professionally trained historians employ historical methods to explain significant events and place them in a meaningful historical context. Here is a broad lesson...that contemporary society can ill afford to ignore."

- Bockstiegel, Karl-Heinz. Editor. *Manned Space Flight*. Cologne: Carl Heymanns Verlag, 1993. This collection of papers delivered at the Institute of Air and Space Law's international colloquium on human spaceflight in May 1992 is not specifically about Apollo but includes information about Apollo missions and an extensive bibliography.
- Booker, Peter Jeffrey; Frewer, G.C.; and, Pardoe, G.K.C. *Project Apollo: The Way to the Moon*. New York: American Elsevier Pub. Co., 1969. A popular and readable account prepared in anticipation of and released just after the Apollo 11 mission in 1969, this book condenses the essential details of 10 years of American space activities into a short narrative. It begins with a discussion of the enormous growth of NASA and the entire space effort in the early 1960s and ends with speculation on future developments in human exploration of the Solar System.
- Bradbury, Ray. "An Impatient Gulliver Above our Roofs." *Life*. 24 November 1967, pp. 31-37. 9 color photos. Story by Ray Bradbury on assignment for *Life* at the Manned Spacecraft Center in Houston and his impressions of the Saturn 5 launch.
- Brian, William L., II. *Moongate: Suppressed Findings of the U.S. Space Program, the NASA-Military Cover-up*. Portland, OR: Future Science Research Pub. Co., 1982. As the title suggests, this is a sensationalistic exposé arguing that "the true circumstances surrounding the Apollo missions and related discoveries were carefully suppressed from the public." The author claims that far from NASA's space program being a civilian effort as advertised, "the military had almost complete control over it and...many NASA findings were withheld from the public." The title of Chapter 10, "Evidence of Extraterrestrial Interference in the Space Program," will suggest the highly speculative and tenuous tenor of the book, much of which is quite technical, to boot. Lightly footnoted with references alike to scholarly sources and *The National Enquirer*, the work should be consulted with great caution by those without a solid grounding in space history and technology.
- Brueton, Diana. *Many Moons: The Myth and Magic, Fact and Fantasy of Our Nearest Heavenly Body*. New York: Prentice Hall Press, 1991. An excellent discussion of the Moon in human legend, lore, science, and popular culture.
- Bruno, Leonard C. "We have a sporting chance": *The Decision to go to the Moon, An Exhibition at the Library of Congress, July 16-September 16, 1979*. Washington: Library of Congress, 1979. This catalog for the tenth anniversary exhibit commemorating Apollo 11 provides an overview in narrative and photos of the background to the mission that carried out President Kennedy's pledge in 1961 to land Americans on the Moon within the decade and return them safely to Earth. Also included is a retrospective reflection on the mission. A good overview with excellent photographs.
- Burgess, Eric. *Outpost on Apollo's Moon*. New York: Columbia University Press, 1993. This heavily illustrated new book argues that employing Apollo hardware on the Moon could permit permanent settlements that would benefit science, humanity, and business. Contains an evaluation of the successes and failures of Apollo as well as how they could be adapted to today's needs.
- Burrows, William E. *Exploring Space: Voyages in the Solar System and Beyond*. New York: Random House, 1990. This journalistic account covers Apollo only in passing but has intelligent things to say about it.

- Butler, S.T., and Messel, H. Editors. *Apollo and the Universe: Selected Lectures on the U.S. Manned Space Flight Program and Selected Fields of Modern Physics and Cosmology*. New York: Pergamon Press, 1968. Most of this small but not short book has nothing to do with Apollo, but the first lecture, "Space Rocketry and a Man on the Moon," by NASA Associate Administrator for Manned Space Flight George E. Mueller devotes a chapter to the Mercury and Gemini programs and another to Apollo as it had evolved until 1968.
- Chamberland, Dennis. "Splashdown!" *Proceedings of the U.S. Naval Institute*. 115 (1989): 36-43. Covers the evolution of spacecraft recovery techniques from Mercury through Apollo.
- Chappell, Russell E. *Apollo*. Washington, DC: National Aeronautics and Space Administration, 1974. Heavy on spectacular photographs, this is an overview not only of Apollo through the lunar landing in July 1969 but also Mercury and Gemini before it.
- Chester, Michael, and McClinton, David. *The Moon: Target for Apollo*. New York: Putnam, 1963. Illustrated with photos and line drawings by Robert Bartram. A pre-Apollo 11 account of what humans learned about the Moon from the third century B.C. to the lunar probes (Pioneer through Ranger).
- Closets, François de. *La lune est à vendre; essai*. Paris: Denoel, 1969. Entitled in English "the Moon is for sale; essay," this little book provides readers of French some thoughtful reflections on humanity's conquest of lunar space.
- Collins, Michael. *Liftoff: The Story of America's Adventure in Space*. New York: Grove Press, 1988. This book, a general history of the U.S. space program for a popular audience written by one of the three participating astronauts in the Apollo 11 flight. He begins with an account of that flight, then flashes back to the post-World War II beginnings of the United States' interest in space and traces the evolution of the space program through the founding of the National Aeronautics and Space Administration (NASA) in 1958 and its launching of the Mercury and Gemini programs to the history of the Apollo program itself. These sections account for roughly two-thirds of the book, with the remainder taking the story of U.S. space exploration through Skylab to the Challenger accident and the prospects for space efforts as they looked in the late 1980s.
- Cooke, Hereward Lester, with the collaboration of Dean, James D. Foreword by J. Carter Brown. Preface by Thomas O. Paine. *Eyewitness to Space: Paintings and Drawings Related to the Apollo Mission to the Moon Selected, with a Few Exceptions, from the Art Program of the National Aeronautics and Space Administration (1963 to 1969)*. New York: H.N. Abrams, 1971. A collection of 258 paintings and drawings in reproduction, created by a variety of artists ranging from Norman Rockwell to Chesley Bonestell. A magnificent and variegated collection.
- Cortright, Edgar M. Editor. *Apollo Expeditions to the Moon*. Washington, DC: NASA SP-350, 1975. This large-formatted volume, with numerous illustrations in both color and black and white, contains essays by numerous luminaries ranging from NASA administrator James E. Webb ("A Perspective on Apollo") to astronauts Michael Collins and Edwin E. Aldrin, Jr. ("The Eagle Has Landed"). By no means a scholarly work, this collection consists rather of the recollections of participants and one correspondent (Robert Sherrod). Among the perspectives offered are those of Robert R. Gilruth on engineering, Wernher von Braun on Saturn, George M. Low on the spaceships, Christopher C. Kraft on mission control, Samuel C. Phillips on the shakedown cruises, and George E. Mueller on "Getting It All Together."
- The Early Years: Mercury to Apollo-Soyuz*. Washington, DC: National Aeronautics and Space Administration, 1988. This 14-page information summary contains brief accounts of projects Mercury, Gemini, Apollo, Skylab, and Apollo-Soyuz with appendices about manned spacecraft and launch vehicles.

- Fairley, Peter. *Man on the Moon*. London: Arthur Barker Limited, 1969. Yet another popular, undocumented account published soon after Apollo 11's conclusion, this volume covers not only that mission but the background to it, the Apollo 204 fire, and the missions yet on the agenda. It also discusses the race with the Soviets.
- Freeman, Marsha. *How We Got to the Moon: The Story of the German Space Pioneers*. Washington, DC: 21st Century Associates, 1993. The author of this book tries to make the German emigres who came to the United States with Wernher von Braun in 1945 the central force behind the success of Project Apollo. Freeman traces all spaceflight ideals and imagination to a German group formed by Hermann Oberth and Willy Ley and including Wernher von Braun, among others, in the first part of the twentieth century, who created the U.S. space program and the "glory" of Apollo. In so doing, she concentrates on such ancillary stories as the development of the V-2 by von Braun's "rocket team" for Germany in World War II, totally ignoring the contributions of other people and nations to the overall space effort.
- Fries, Sylvia D. *NASA Engineers and the Age of Apollo*. Washington, DC: NASA SP-4104, 1992. This book is a sociocultural analysis of a selection of engineers at NASA who worked on Project Apollo. It analyzes the manner in which different personalities, perspectives, backgrounds, and priorities came together to inform the direction of NASA during the 1960s. The author makes extensive use of oral history in this study, providing both a significant appraisal of NASA during its "golden age" and important documentary material for future explorations.
- Furniss, Tim. "One Small Step"—*The Apollo Missions, the Astronauts, the Aftermath: A Twenty Year Perspective*. Somerset, England: G.T. Foulis & Co., 1989. Developed for a retrospective celebration on the twentieth anniversary of the lunar landing, this book tries to recreate the exhilaration of the Apollo missions.
- Gregory, William H. "Project Apollo in Retrospect." In Ordway, Frederick I., III and Liebermann, Randy. *Blueprint for Space: Science Fiction to Science Fact*. Washington, DC: Smithsonian Institution Press, 1992. Pp. 155-65. Provides a good, brief overview of the entire Apollo program from background through inception to its completion with the splashdown of Apollo 17 on 19 December 1972. It covers the major management decisions, technological achievements, and political contexts as well as providing perspective on the program from the vantage point of two decades after the events. Also includes a brief bibliography.
- Hallion, Richard P., and Crouch, Tom D. Editors. *Apollo: Ten Years Since Tranquility Base*. Washington, DC: Smithsonian Institution Press, 1979. This is a collection of essays developed for the National Air and Space Museum, commemorating the tenth anniversary of the first landing on the Moon, July 20, 1969. It consists of sixteen articles, mostly written directly for the National Air and Space Museum by a variety of experts, that range from Roger E. Bilstein's overview entitled, "The Saturn Launch Vehicle Family," to Kerry M. Joëls' "Apollo and the 'Two Cultures'." Other contributions by such luminaries as John M. Logsdon; Frederick C. Durant, III; Farouk El-Baz; and Rocco A. Petrone, not to mention the two editors, attempt to set the Apollo missions in historical perspective and to explain such matters as operational support, the command and service modules, the lunar module, and the Apollo space suit. Dominick A. Pisano has provided a selective bibliography at the conclusion of the volume.
- Hechler, Ken. *Toward the Endless Frontier: History of the Committee on Science and Technology, 1959-1979*. Washington, DC: U.S. House of Representatives, 1980. This lengthy tome contains the best account to date of Congressional wrangling over Project Apollo, and demonstrates the bipartisan nature of both Apollo support and opposition.
- Hirsch, Richard, and Trento, Joseph John. *The National Aeronautics and Space Administration*. New York: Praeger, 1973. A popularly written overview of the agency in Praeger's Library of U.S. Government

Departments and Agencies, this critical but by no means scholarly account offers one chapter and scattered other references to Apollo.

Holmes, Jay. *America on the Moon*. Philadelphia: L.B. Lippincott, 1962. This popular account without scholarly apparatus provides an early look at the Apollo program and its background. Useful for its perspective on how Apollo in its beginnings looked to one investigator.

"How An Idea No One Wanted Grew Up To Be the LEM." *Life*. 14 March 1969, pp. cover, 20-27. 8 color photos, 1 color painting, 4 B&W sketches. A fascinating look at the evolution of the Lunar Excursion Module. Also discusses how the lunar rendezvous scheme was picked.

Hoyt, Edwin P. *The Space Dealers: A Hard Look at the Role of Business in the U.S. Space Effort*. New York: The John Day Co., 1971. This book describes the intricate interrelationships between government organizations such as NASA and the aerospace industry. Not specifically focused on Apollo, it uses that program as a test case in looking at the larger question of government/industry relations.

Hurt, Harry, III. *For All Mankind*. New York: Atlantic Monthly Press, 1988. Another attempt, really quite a lame one by a correspondent for *Newsweek*, to provide a compelling and convincing narrative of Project Apollo.

Kane, Francis X. "The NASA Program." *Air University Review*. 14 (Winter-Spring 1962-3): 189-204. This undocumented article by an Air Force officer discusses especially Air Force support for NASA programs, including but not focussing exclusively on Mercury, Gemini, and Apollo.

Kaysing, Bill and Reid, Randy. *We Never Went to the Moon: America's 30 Billion Dollar Swindle*. Cornville, AZ: Desert Publications, 1981. This curious and cheaply-put-together compilation concludes without documentation or real evidence that "THE TRIP TO THE MOON WAS A HOAX"—to use the typography as well as the words in the authors' conclusions. Hardly definitive!

Knight, David C. Compiler. *American Astronauts and Spacecraft: A Pictorial History from Project Mercury through Apollo 13*. New York: F. Watts, 1970. This (mostly black and white) pictorial history consists almost entirely of photos, some of them with lengthy captions. It does contain useful biographies of the astronauts and a lengthy glossary of space terms.

Launius, Roger D. *NASA: A History of the U.S. Civil Space Program*. Melbourne, FL: Krieger, 1994. A short book in the Anvil Series, this history of U.S. civilian space efforts consists half of narrative and half of documents. It contains three chapters on the Apollo program plus two others on the Sputnik crisis and the events leading up to the creation of NASA and one dealing with the rise of space science and technology. While coverage consists more of overview than detailed analysis, the approach is broadly analytical and provides the most recent general treatment of its topic, designed more for the student or general reader than for the specialist.

Levine, Arthur L. *The Future of the U.S. Space Program*. New York: Praeger Publishers, 1975. Despite its somewhat misleading title, most of this book by a long-time NASA employee who later moved to academia deals with the history of the agency. Chapters 4 and 5 cover the space program during roughly the Apollo period.

Lewis, Richard S. *Appointment on the Moon: The Inside Story of America's Space Adventure*. New York: Viking, 1969. Perhaps the first book to capitalize on the success of Apollo 11 in 1969, this history appeared within days of the "splashdown."

- \_\_\_\_\_. *The Voyages of Apollo: The Exploration of the Moon*. New York: Quadrangle, 1974. This popularly written but not nontechnical account covers the background to the Apollo mission seen as an exploration of the Moon. It then discusses the changes in our perceptions of that heavenly body as succeeding Apollo missions added to our knowledge. Without scholarly apparatus, this is clearly a non-scientist's interpretation of lunar science, but it presents an informed series of perspectives as of the time it was written.
- Life in Space*. Boston: Little, Brown and Co., 1983. A look at the U.S. space program from Project Mercury through the Space Shuttle and planetary explorers. Tremendous collection of photos, most culled from the *Life* collection. Covers all manned missions.
- Lindbergh, Anne Morrow. *Earth Shine*. New York: Harcourt, Brace & World, 1969. A republication of the article described below and one on East Africa together with some reflections on how the two are linked together.
- \_\_\_\_\_. "The Heron and the Astronaut." *Life*. 28 February 1969, pp. 1, 14-27. Impressionistic story about Cape Kennedy, the launch of Apollo 8, and what Apollo 11 means for mankind, complete with a number of photographs.
- Logsdon, John M., et al. *Apollo in its Historical Context*. Washington, DC: George Washington University Space Policy Institute, 1990. This edited version of remarks presented at a 1989 symposium includes articles by Logsdon on "Evaluating Apollo"; Walter A. McDougall on "Apollo and Technocracy"; Daniel J. Boorstin on "The Rise of Public Discovery"; and Frank White on "Apollo in a Millennial Perspective." Concludes with a discussion based on questions from the audience at the symposium. Useful for the perspectives offered by the four eminent participants.
- \_\_\_\_\_. "An Apollo Perspective." *Astronautics & Aeronautics*. 17 (December 1979): 112-116. This brief article analyzes the situation facing the U. S. space program in 1979 in the light of Apollo and concludes that the base of support for a major national investment in space, such as the one that existed for Apollo in 1961 simply did not exist 18 years later and was unlikely to emerge again for a considerable time in the future.
- \_\_\_\_\_. "From Apollo to Shuttle: Policy Making in the Post Apollo Era." Unpublished typescript, Spring 1983, copy in NASA History Office Reference Collection. This lengthy "Partial and Preliminary Manuscript" is concerned primarily with the "decisions taken during the 1969-1972 period on what the United States would do in space after landing on the moon." However, since these decisions were made in the context of Apollo the author does discuss it as well.
- Low, George M. "What Made Apollo a Success? Introduction." *Astronautics and Aeronautics*. (March 1970): 36-45. This brief article by the NASA deputy administrator at the time and former manager of the Apollo spacecraft program discusses a range of issues involved in Apollo's successes to date, including spacecraft design and development, mission design and planning, flight-crew and flight operations, spacecraft test activities, and management's control of spacecraft changes. Although not entirely free of jargon, this is generally a readable and well-written analysis. It concludes that the preeminent factor in Apollo's success was attention to detail coupled with dedication.
- Lutman, C. C. "The Apollo Program." *Air University Review*. 16 (May-June 1965): 16-21. This short, undocumented article by an Air Force officer who had served in NASA concentrates on spacecraft, guidance and navigation systems, instrumentation and scientific equipment, and operations with emphasis on the fact "that the Apollo program is not aimed solely at the successful completion of a lunar landing but rather is a tool employed to obtain and keep U.S. supremacy in space."

Lyndon B. Johnson Space Center. *Apollo Program Summary Report*. Houston, TX: Lyndon B. Johnson Space Center, 1975. This lengthy report summarizes the principal activities during Apollo and provides references for those seeking greater detail. It is divided into sections on the flight program, science, vehicle development and performance, spacecraft development testing, the flight crew, mission operations, biomedical matters, spacecraft manufacturing and testing, launch facilities and operations, and the lunar receiving laboratory, which initially quarantined astronaut crews and handled lunar samples. Illustrations and appendices supplement the text. This report probably gives the most complete overview of the program to be found anywhere and may be the best single place for researchers new to Apollo to begin.

Mailer, Norman. "A Dream of the Future's Face." *Life*. 9 January 1970, pp. 56-57, 60, 62, 62-63, 64, 66, 68, 70, 72, 74. 2 color photos. Part III of Norman Mailer's *Fire on the Moon* examines some "philosophical" questions on where society is headed.

\_\_\_\_\_. "A Fire on the Moon." *Life*. 29 August 1969, pp. cover, 1, 24-42. 4 color photos. Part I of Norman Mailer's personal study of the U.S. space program. Includes transcripts of the Public Affairs Officer's Apollo 11 countdown. Also, "Men In Space," p. 46A.

\_\_\_\_\_. *Of a Fire on the Moon*. Boston: Little, Brown, 1970. London, Weidenfeld & Nicolson, 1970. New York: New American Library, 1971. One of the foremost contemporary American writers, Mailer was commissioned to comment on the first lunar landing. What he wrote was this rather confused and confusing account that is written as a series of almost stream-of-consciousness ruminations about spaceflight. They do provide some insights, most importantly as Mailer with his 1960s countercultural mindset meets its antithesis, a NASA steeped in middle class values and reverence for the American flag and culture. Mailer was forced, grudgingly, to admit that NASA's approach to task accomplishment—which he sees as the embodiment of the Protestant Work Ethic—and its technological and scientific capability got results with Apollo. He rails at NASA's closed and austere society, one where he says outsiders are distrusted and held at arm's length with a bland and faceless courtesy that betrays nothing. For all of its skepticism, for all of its esotericism, the book captures some interesting insights into rocket technology and the people who produced it in Project Apollo, but it is heavy going to extract them from this dense book.

Manno, Jack. *Arming the Heavens*. New York: Dodd, Mead, 1988. This sparsely documented volume with an extensive annotated bibliography begins the account by tracing the "Nazi legacy" of the space program back to Wernher von Braun and the ballistic missile program at Peenemünde. The book's thrust is suggested by the concluding paragraph to Chapter 16, "The Space Warriors Return," referring to the presidency of Ronald Reagan and the end it signalled to "U.S. efforts even to pretend that American space activities would be devoted to peaceful purposes. That paragraph reads: "The new arms race in space is but another example—perhaps the last one—of leaders refusing to accept the limits of military power, of trying therefore to bring military solutions to bear on what are global political and social crises. The only real hope for national security in the Space Age lies in international security. Global social and political solutions must be sought for the global social and political problems that lead to war." Many readers may disagree with this approach, but the author presents a reasoned if not scholarly argument in support of it.

Mansfield, John M. *Man on the Moon*. New York: Stein and Day, 1969. Written by a BBC television producer, this book begins with ancient conceptions of the Moon and continues with theoretical foundations for the space age in the works of science fiction authors and theoreticians. The book's capstone is a discussion of NASA and Project Apollo.

Masursky, Harold; Colton, G.W.; and El-Baz, Farouk. *Apollo Over the Moon: A View from Orbit*. Washington, DC: National Aeronautics and Space Administration SP-362, 1978. This is an excellent encapsulation of the Apollo program with striking photography. A large-formatted book, it contains an introduction discussing the objectives, methods, and results of Apollo lunar photography. It follows this with discussions

of the regions of the Moon and explanations of individual photographs. Contains a glossary and bibliography.

Messel, H., and Butler, S. T. Editors. *Pioneering in Outer Space*. London: Heinemann, 1971. This published series of lectures contains historical material on all human space flights up to Apollo 13. The core of the book consists of chapters by G. Hage, vice president for development at Boeing; G. E. Mueller, then vice-president of general dynamics but previously NASA associate administrator for manned space flight; and Lee B. James, director of lunar operations at the Marshall Space Flight Center, dealing with U.S. spaceflights, including accounts of the development of the Saturn launch vehicles and the Apollo spacecraft, astronaut selection and training, the individual Apollo missions, their scientific results, and their impact on Earth plus projections for the future. Intended for advanced high school students, the prose is pedestrian but clear with numerous black and white illustrations.

Milne, Donald Stewart. *Footprints on the Moon*. Auckland: Wilson & Horton, 1969. This cheaply-produced volume by a journalist from New Zealand covers the background to space exploration, the Soviet space program, and Project Apollo. One of many popular accounts with numerous newsprint-quality photos.

Moore, P. *Moon Flight Atlas*. Chicago: Rand McNally, 1970. This 64-page "atlas" contains many photographs as well as maps and descriptive materials describing what was known about the Moon shortly after the first lunar landing. It also contains material and diagrams about the Apollo program and its hardware, followed by run-downs of Apollo missions.

Murray, Bruce. *Journey into Space: The First Three Decades of Space Exploration*. New York: W.W. Norton and Co., 1989. This highly personal account by a former director of the Jet Propulsion Laboratory makes only occasional reference to Apollo but does have some interesting reflections about it and its legacy for NASA.

Murray, Charles A., and Cox, Catherine Bly. *Apollo, the Race to the Moon*. New York: Simon and Schuster, 1989. Perhaps the best general account of the lunar program, this history uses interviews and documents to reconstruct the stories of the people who participated in Apollo.

NASA. *America's Next Decades in Space: A Report for the Space Task Group*. Washington, DC: NASA, 1969. Mostly about the future after Apollo, this report contains a lengthy chapter on "Current Program and National Capabilities" that gives considerable attention to Apollo and its infrastructure.

NASA History Office [authors vary, with many of the volumes sponsored by the NASA Historical Staff but prepared by the Science and Technology Division of the Library of Congress], *Astronautics and Aeronautics...* [title varies]. Washington, DC: NASA SPs-4004 to 4020, 1963-1975. This series—which was preceded by NASA reports for 1961 and 1962 to the Committee on Science and Astronautics, U.S. House of Representatives, published as committee prints entitled *Astronautical and Aeronautical Events of ...* — does not focus exclusively on Apollo by any means. But the annual chronologies do contain much information about specific events relating to Apollo and provide a handy reference tool.

NASA Office of Manned Space Flight. *Apollo Reliability and Quality Assurance Program Plan*. Washington, DC: National Aeronautics and Space Administration, 1966. This document, prepared by the Apollo Program Office, outlines the requirements for hardware development under the Apollo program. While it makes dull and bureaucratic reading, it outlines the procedures followed until the Apollo 204 fire the following year and thus provides a baseline against which to measure the changes introduced in reliability and quality assurance in its aftermath. (See Apollo Accident Report and the congressional committee prints [listed under U.S. House below in Chapter 5] on that incident and its results for NASA procedures.)

NASA Office of Manned Space Flight. *Apollo Terminology*. Washington, DC: NASA SP-6001, 1963. A glossary of terms used in the program with their definitions. In view of the inclination of even popular accounts of the program to use acronyms and technical terms, this is a virtually indispensable reference work for those not already familiar with the terminology.

NASA Office of Manned Space Flight. *NASA's Manned Space Flight Program*. Washington, DC: National Aeronautics and Space Administration, 29 April 1969. Describes the efforts of NASA to place men in orbit and on the Moon. It also discusses the next phase of manned flight, the development of a reusable spacecraft for movement of people and supplies to and from orbit. A reprint of part of NASA testimony to Congress during budget authorization hearings for fiscal year 1970.

NASA Office of Public Affairs. *"In this decade ...": Mission to the Moon*. Washington, DC: NASA, 1969. This public relations brochure with lots of photos and a somewhat breezy style nevertheless provides considerable information about the Apollo program on the eve of the first lunar landing.

NASA Space Task Group. *The Post-Apollo Space Program: Directions for the Future*. Washington, DC: Government Printing Office, September 1969. Mostly about the future, this report includes background material on Apollo and its effects.

*The Next Decade in Space: A Report of the Space Science and Technology Panel of the President's Science Advisory Committee*. Washington, DC: President's Science Advisory Committee, March 1970. This important report reviews the development of the space program in the United States through the Moon landing and projects some future objectives for the President.

Newman, Joseph. *U.S. on the Moon*. Washington, DC: U.S. News and World Report Inc., 1969. This popular account of the Apollo program through Apollo 11, with coverage of its background and of the race with the Soviets, provides a fair summation in understandable language of what was known at the time.

*One Giant Leap for Mankind*, with Introduction by Eugene Cernan. Largo, FL: Rococo International, Inc., [1994]. This glossy 25th anniversary publication contains a series of articles by Karl E. Kristofferson and others dealing with NASA's Centers, "The Rocket Meisters," projects Mercury through Apollo, Apollo-Soyuz, "Buggy On The Moon," "The Lunar Machines," "How Television Made it to the Moon," and several other non-Apollo-related topics. Without notes or other scholarly apparatus, this is intended for a popular audience.

"One Last Fiery Hurrah for Apollo." *Life*. 19 December 1972, pp. 6-8C. Includes several entries covering not just Apollo 17 but the Apollo program as a whole, including hardware.

Ordway, Frederick I., III, and Sharpe, Mitchell R. Foreword by Wernher von Braun. *The Rocket Team*. New York: Crowell, 1979. This is an important, popularly-oriented, and somewhat apologetic discussion of the activities of the group of German engineers under the leadership of Wernher von Braun who developed the V-2 in World War II, came to the United States in 1945, and worked at the Marshall Spaceflight Center at Huntsville, Alabama, to develop the Saturn V launch vehicle used in Project Apollo.

\_\_\_\_\_. Adams, Carsbie C.; and Sharpe, Mitchell R. *Dividends from Space*. New York: Thomas Y. Crowell, 1972. This is an attempt to show that the costs of the space program have been more than returned in benefits to humanity, both tangible and intangible. The authors discuss at length the use of space systems to improve weather forecasting, facilitate communications, and inventory Earth resources. They also emphasize the development of the technological base with such major programs as Project Apollo.

Peterson, Robert W. *Space: From Gemini to the Moon and Beyond*. New York: Facts on File, 1972. A now obviously dated reference work summarizing events related to space from 1965-1971 in a topical format with each section organized chronologically. Does provide the perspective as of nearly the end of the Apollo program.

*Peterson's Book of Man in Space*. Los Angeles, CA: Petersen Pub. Co., 1974. 5 volumes. In essentially magazine format with lots of photos, this series of articles carries the story of humans in space from accounts of the spaceflight pioneers Robert H. Goddard and Konstantin E. Tsiolkovsky through Mercury, Gemini, and Apollo.

Petroski, Henry. *To Engineer is Human: The Role of Failure in Successful Design*. New York: St. Martin's Press, 1985. This book offers a series of reflections upon the relationship between engineering and risk. The author comments on the development of a special faith attached to modern technology in the public mind, and the effect recent disasters, from Three-mile Island to Chernobyl, had on that confidence. This book is not simply a chronicle of accidents, but seeks to look at the process of engineering and its creative aspects apart from its scientific ones. Petroski notes that the design process accepts failure and seeks to test and gradually develop a system, whatever it might be, that has an acceptable level of risk to operate. He cautions that nothing is error free. He ends with a discussion of structural failures and their causes, dividing them into several categories. He notes that many recent failures are not due to engineering but to poor construction, inferior materials, inadequate attention to detail, or poor management and oversight.

Rabinowitch, Eugene, and Lewis, Richard S. Editors. *Man on the Moon: The Impact on Science, Technology, and International Cooperation*. New York: Basic Books, 1969. The editors have assembled articles that provide a range of views on the impact of the exploration of space on science, technology, and international cooperation. Each author approaches the subject from a particular perspective, speculating on the meaning of the Apollo lunar landing and offering prognostications for the future.

*Rover and Men on the Moon: Man's Greatest Adventure*. Bonita Springs, FL: Holland Posters, 1971. A picture book, largely about the Apollo program, with shots of the lunar roving vehicle.

Ryan, Peter. *Invasion of the Moon, 1969: The Story of Apollo 11*. Harmondsworth, UK: Penguin, 1969; second ed. published in 1971 under title: *The Invasion of the Moon, 1957-1970*. This book capitalizes on the excitement of the first Apollo landing, providing a recitation of the expedition for a popular audience. Rather more detailed than many popular accounts, this book went into a second edition that carried the narrative through Apollo 13. Also covers the Soviet space program.

Shelton, William Roy. *Man's Conquest of Space*. Washington, DC: National Geographic Society, 1974. A popular account with many photographs of the entire human spaceflight effort to 1974, including Apollo but also science fiction, the alien environment of space, the Soviet space program, and much else.

Society of Automotive Engineers. *Apollo: A Program Review*. New York: The Society, 1964. "Papers presented verbally at the 1964 National Aeronautic and Space Engineering meeting held in Los Angeles, California."

*Spirit of Apollo: A Collection of Reflective Interviews Commemorating the 20th Anniversary of the First Manned Lunar Landing*. Washington, DC: American Institute of Aeronautics and Astronautics in cooperation with the AIAA Houston Section, 1989. This glossy collection of interviews with 15 astronauts, managers, and others involved in the Apollo program provides some perspective on the events 20 years after the landing on the Moon. Among the interviewees were Eugene Cernan, Aaron Cohen, Maxime Faget, Robert Gilruth, Christopher Kraft, and Donald "Deke" Slayton.

Sullivan, Walter. Editor. *America's Race for the Moon: The New York Times Story of Project Apollo*. Foreword by D. Brainerd Holmes. New York: Random House, 1962. This is a collection of articles that appeared in the *Times*. Probably its only value today lies in giving a sense of the information available to the interested lay reader at the time.

Sutton, Felix. *Conquest of the Moon*. New York: Grosset & Dunlap, 1969. This 63-page picture book has for its text sixty questions and answers about Earth's natural satellite and the program to reach it.

Swenson, Loyd S., Jr. "The Fertile Crescent: The South's Role in the National Space Program." *Southwestern Historical Quarterly*. 71 (January 1968): 377-92. A discussion of the NASA centers established in the South, especially those associated with Project Apollo (Marshall Space Flight Center, Kennedy Space Center, Mississippi Test Facility, and Manned Spacecraft Center [later Lyndon B. Johnson Space Center]), and their impact on the region.

Thomas, Davis. Editor. *Moon: Man's Greatest Adventure*. New York: H.N. Abrams, 1970. A large-format, illustrated work whose centerpiece consists of three major essays. One, by Fred A. Whipple, Harvard University astronomer, describes the possibilities of space flight for scientific inquiry. Another by Silvio A. Bedini, of the Smithsonian Institution, deals with the Moon's role in human affairs. A final article by Wernher von Braun of NASA analyzes Project Apollo and its execution in the 1960s.

United States House, Committee on Science and Technology, Subcommittee on Space Science and Applications. *United States Civilian Space Programs, 1958-1978*. Washington, DC: U.S. Government Printing Office, 1981. This more than 1,000-page report has the usual introduction and summary, followed by a list of issues for congressional consideration, a history of NASA and its relation to American space policy, and accounts of "NASA Facilities and Tracking Systems," "Launch Vehicles and Propulsion," "Manned Space Flight Through 1975," and a variety of other topics, most of them unrelated to Apollo. In the introduction and summary written by Marcia S. Smith, one comment is that the "manned space program, which saw six two-man crews land on the surface of the Moon and return safely to Earth, has received the most media and public attention..." but adds that it is only one part of the space program.

United States Information Agency. *Effect of the Moon Landing on Opinions in Six Countries*. Washington, DC: USIA, 1969. Copy in the NASA Historical Reference Collection, NASA Headquarters, Washington, DC. This research report, which was not made available to the general public until 1971, contains 7 tables and 11 charts in addition to 15 pages of text. It concluded from opinion surveys conducted immediately before and after Apollo 11 that the "U.S. standing in science" and space exploration improved considerably following the successful Moon landing in Great Britain, India, France, Japan, Venezuela, and the Philippines but that opinions of U.S. military strength rose only in Britain, France, and Japan, and there only slightly.

Van Dyke, Vernon. *Pride and Power: The Rationale of the Space Program*. Urbana: University of Illinois Press, 1964. This analysis of the overall rationale of the Apollo program came to the conclusion that the "most powerful motives" behind it involved competition with the Soviet Union. "Motives such as the promotion of scientific, technological, and economic progress" were "less compelling in political circles" though elsewhere one or the other of them may have been more central. Although mostly about these motivations, this carefully researched book by an academic, also discusses organizational arrangements; relations among NASA, the business world, and universities; international cooperation; and NASA's public information programs. Although his research is certainly dated, Van Dyke's conclusions hold up surprisingly well after the passage of 30 years.

von Braun, Wernher. *First Men to the Moon*. New York: Holt, Rinehart and Winston, 1966. A popular account of Apollo based on a series of articles appearing in *This Week* magazine. Its greatest strength is the inclusion of easily understood diagrams of scientific phenomena and hardware.

\_\_\_\_\_. and Ordway, Frederick I., III. *History of Rocketry and Space Travel*. New York: Thomas Y. Crowell, 1969, 2d edition. This is a large-format, illustrated history that emphasizes the history of the U.S. space program and Project Apollo. It was written by one of the most significant popularizers of space flight and one of his leading space information specialists.

\_\_\_\_\_. *Space Travel*. New York: Harper & Row, 1985. This update of *History of Rocketry & Space Travel* contains an excellent summary of the early visions of space flight.

Weaver, Kenneth F. "What the Moon Rocks Tell Us." *National Geographic Magazine*. 136 (December 1969): 788-91. A popular rather than scientific account of the moon rocks. Together with "Next Steps in Space" by NASA Administrator Thomas O. Paine (pp. 792-7), this rounds out the "First Explorers on the Moon" series in this issue (see Chapter 5, Apollo 11).

*What Made Apollo a Success?* Washington, DC: NASA SP-287, 1971. A reprint of articles by George M. Low, Kenneth S. Kleinknecht, Scott H. Simpkinson, Christopher C. Kraft, and others from the March 1970 issue of *Astronautics & Aeronautics*. Each of these articles is discussed separately in the appropriate sections of this bibliography.

Wilbur, Ted. "Support Forces." In Wilbur, Ted. *Space—And the United States Navy*. Prepared by the Editors of *Naval Aviation News* (November 1970): 73-77. Covers various support the Navy provided for NASA during Mercury, Gemini, and Apollo ranging from satellite information through recovery following splashdown of spacecraft.

Young, Hugo; Silcock, Bryan; and Dunn, Peter. *Journey to Tranquility: The History of Man's Assault on the Moon*. Garden City, NY: Doubleday, 1970. A ponderous "anti-Apollo" broadside, this book seeks to cast aspersions on the entire space program. Handled deftly by investigative journalists who are writing an exposé, the first chapter sets the stage by characterizing Wernher von Braun as a self-righteous traitor and John F. Kennedy as an adolescent exhibitionist. They then describe a conspiracy of bureaucrats, industrialists, and politicians who promote space as a means of feathering their own nests. The authors used the Apollo fire that killed three astronauts as the evidence that "proves" the dishonesty and criminal behavior of NASA and other space advocates. The authors were journalists with the *London Sunday Times* and they provided a fast-paced if highly critical analysis of Project Apollo.

## CHAPTER 2

# THE SPACE RACE

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- Breuer, William B. *Race to the Moon: America's Duel with the Soviets*. Westport, CT: Praeger, 1993. This book, written by a journalist who has made a career out of writing World War II adventures, is neither about the race to the Moon nor the U.S. rivalry with the U.S.S.R. The majority of it is, instead, about the World War II efforts of the German rocket team under Wernher von Braun at Peenemünde, their wartime exploits, their surrender to American forces in 1945, and their post-war activities in the U.S. Only 6 of 24 chapters actually deal with Project Apollo, and none of the book goes beyond the popular literature on either the Germans or Apollo.
- Bulkeley, Rip. *The Sputniks Crisis and Early United States Space Policy: A Critique of the Historiography of Space*. Bloomington: Indiana University Press, 1991. This is an important discussion of early efforts to develop civil space policy in the aftermath of the Sputnik crisis of 1957. Not explicitly concerned with Project Apollo, it does contain much information relative to the rivalry between the United State and the Soviet Union and how it was affected by the launching of the Sputnik 1 scientific satellite. It also discusses the debate that took place within the Eisenhower administration over whether or not to begin an aggressive lunar landing program, the program that ultimately became Apollo. Eisenhower always opposed the idea of an aggressive lunar landing program, for as he said at a meeting in February 1958 "he would rather have a good Redstone than be able to hit the moon, for we didn't have any enemies on the moon."
- Caiden, Martin. *War for the Moon*. New York: E.P. Dutton and Co., 1959. This presents a strong case for the U.S. to rush to the Moon, framed in the context of the Cold War rivalry with the Soviet Union, written at the time that the first lunar probes were being launched.
- Clark, Philip S. *The Soviet Manned Space Program*. New York: Crown Pub., Orion Books, 1988. This is a general historical work on the Soviet space effort, emphasizing the Cold War rivalries with the United States and how they related to several programs, especially the race to the Moon.
- \_\_\_\_\_. "Chelomei's Alternative Manned Lunar Program." *Quest: The History of Spaceflight Magazine*. 1 (Winter 1992): 31-34. Vladimir Chelomei was one of the leading spacecraft designers in the Soviet Union in the 1960s. As one of the leading rivals to Sergei Korolev's efforts in space, Chelomei's design bureau offered several different proposals for a lunar landing program to beat the Americans. He was unsuccessful in obtaining approval for these programs, but that fact that they existed indicates that the Soviet leadership could not agree on a method of racing the Americans to the Moon. This article describes the plans proposed by Chelomei.
- \_\_\_\_\_. "The Soviet Manned Circumlunar Program." *Quest: The History of Spaceflight Magazine*. 1 (Winter 1992): 17-20. This is a solid article based on post-Cold War documentation that describes the Soviet effort to send a piloted spacecraft around the Moon before the Americans did so. Heavily illustrated, and with tables showing major events in the program.
- Cox, Donald W. *America's Explorers of Space; Including a Special Report on Project Apollo*. Maplewood, NJ: Hammond, 1969. This is a short, 96-page, illustrated history of the rivalry between the Soviet Union and the United States to the Moon. It is a revision of the 1962 publication by the same author (see below), the new edition being issued to capitalize on the success of Apollo 11.

- \_\_\_\_\_. *The Space Race: From Sputnik to Apollo, and Beyond*. Philadelphia: Chilton Books, 1962. This is a short and rather simplistic account by a journalist of the major points of the international rivalry between the United States and the Soviet Union on the use of space for prestige purposes. It discusses in elementary fashion the Sputnik crisis and the Gagarin 1961 orbital mission before describing the Kennedy decision to enter the Moon race and NASA's early efforts to accomplish it through Project Apollo.
- Daniloff, Nicholas. *The Kremlin and the Cosmos*. New York: Alfred A. Knopf, 1972. A journalistic account of the Soviet space program with some discussion of the race to the Moon.
- Divine, Robert A. *The Sputnik Challenge*. New York: Oxford University Press, 1993. This book, while not dealing with Project Apollo explicitly, is concerned with Eisenhower's reaction to the Soviet launch of the Sputnik satellite in 1957. It contains insights into an ill-formed "alternative" space program promoted by the Eisenhower White House that emphasized a modest effort using satellites for exploration and practical applications rather than the aggressive and expensive piloted space flight program desired by space promoters and NASA leaders.
- Doel, Ronald E. "Evaluating Soviet Lunar Science in Cold War America." *Osiris*. 7 (1992): 238-64. An excellent discussion of the efforts of the U.S. scientific and governmental establishment to ascertain what research the Soviets were doing relative to the Moon, along with an analysis of Soviet lunar science's findings.
- Dupas, Alain. *La lutte pour l'espace (The Battle for Space)*. Paris: Seuil, 1977. This French-language book contains a discussion of the U.S./U.S.S.R. rivalry in space and the lunar programs that resulted from it.
- Glennan, T. Keith. *The Birth of NASA: The Diary of T. Keith Glennan*. Edited by J.D. Hunley. Washington, DC: NASA SP-4106, 1993. This diary of Eisenhower's NASA administrator contains a detailed account of the discussions that took place prior to 1961 on the viability and desirability of undertaking an aggressive lunar landing program as a means of demonstrating national superiority over the Soviet Union. As administrator Glennan sponsored studies on the possibility of Project Apollo, but he always shied away from an aggressive stance on the effort. Funding for studies of the proposal were included in the NASA budgets for fiscal years 1961 and 1962 by Glennan, but he was unwilling to move beyond that stage until fundamental work on other space activities had been completed. After leaving office, Glennan watched the Apollo project closely and while admitting that he was excited by the lunar landing in 1969, he recognized that it was the capstone of a project he believed had been ill-advised and costly. An introduction to the diary by Roger D. Launius shows how Glennan's background prepared him for his duties as NASA's first administrator.
- Harvey, Brian. "Promise Unfulfilled: The Soviet Unmanned Moon Programme, 1969-1988." *Journal of the British Interplanetary Society*. 43 (1990): 395-98. A solid discussion of the later efforts of the Soviet Union to explore the Moon with robotic probes using information made available in the post-Cold War era.
- \_\_\_\_\_. *Race into Space: The Soviet Space Programme*. Chichester, England: Ellis Horwood Ltd., 1988. This is a solid history of the development of the Soviet space program through the mid-1980s. It has several chapters on the lunar program, describing what information was available before the official Russian announcement of the race in 1989.
- Jastrow, Robert, and Newell, Homer E. "The Space Program and the National Interest." *Foreign Affairs*. 50 (April 1972): 532-44. This article is not specifically related to Apollo, but it presents an argument in an important forum about the nature of the space program and comments on the lunar landing program in relation to it. The authors contend that the American space program sprang principally from considerations of national security and international prestige. That motivated most of its efforts toward Apollo in the 1960s and has informed them since that time.

Johnson, Nicholas L. "Apollo and Zond—Race around the Moon." *Spaceflight*. 20 (December 1978): 403-412. This retrospective article written ten years after Apollo 8 compares what was known then about Apollo with information about the Soviet lunar program, called Zond. The author notes the incredible parallelism of events in the two programs, including the Apollo 204 and Soyuz 1 disasters in early 1967, and concludes that the United States and the Soviet Union were in a race to send humans around the Moon in 1968, despite Soviet claims to the contrary.

\_\_\_\_\_. *The Soviet Reach for the Moon: The L-1 and L-3 Manned Lunar Program and the Story of the N-1 (Moon Rocket)*. Washington, DC: Cosmos Books, 1994. This is a heavily-illustrated volume containing a wealth of information about the history of the Soviet Union's efforts to race the United States to the Moon in the 1960s. It incorporates much of the recently available information on the Soviet lunar program and describes how the USSR's very real efforts to reach the Moon failed.

Killian, James R., Jr. *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology*. Cambridge, MA: MIT Press, 1977. In the wake of the Soviet orbiting of Sputnik in 1957, President Dwight D. Eisenhower appointed a science advisor to his White House staff, James R. Killian from the Massachusetts Institute of Technology. Killian's memoir describes in detail the debates over what course to take with the civil space program and whether or not to enter a Moon race with the Soviet Union.

Kistiakowsky, George B. *A Scientist in the White House*. Introduction by Charles S. Maier. Cambridge, MA: Harvard University Press, 1976. This is the edited diary of George B. Kistiakowsky, the second science advisor to President Eisenhower. Taking office in July 1959, he had previously served on James Killian's advisory committee and was well aware of the efforts to best the Soviet Union in space. This diary is revealing about the efforts to keep the space program small and of the pressure brought to bear on the administration to race to the Moon.

Koelle, Heinz-Hermann. "Lunar Development, Past and Future: Part 1-Apollo was a Race." *Spaceflight*. 35 (February 1993): 48-51. Discusses the development of the concept of sending humans to the Moon and describes the U.S. effort with Project Apollo. Places it in the context of the Cold War, and then continues with a discussion of the possibility of going back to the Moon at the end of the twentieth century.

Landis, Rob R. "The N-1 and the Soviet Manned Lunar Landing Program." *Quest: The History of Spaceflight Magazine*. 1 (Winter 1992): 21-30. The N-1 launcher was to have been the super-rocket that would have taken Soviet cosmonauts to the Moon in the 1960s. Although it was officially denied until 1989, since then there have been several discussions of the development of the N-1. This article reviews the project, its configuration for circumlunar flight, the lunar lander it was to carry, and the unsuccessful test program of the launch vehicle.

Lebedev, Daniel A. "The N1-L3 Programme." *Spaceflight*. 34 (September 1992): 288-90. This is a useful discussion of the development of the lunar landing booster, spacecraft, and lander under development by the Soviet Union in the 1960s. It is based on sources that came out of Russia with the end of the Cold War.

Lebedev, L.; Lyk'yanov, B.; and Romanov, A. *Sons of the Blue Planet*. New Delhi: Amerind Pub. Co., 1973. Translated from the Russian and published for the National Aeronautics and Space Administration and the National Science Foundation. This book is a basic history of the Soviet space program through the 1960s. It is silent on the possibility of a lunar landing program.

Leskov, Sergei. "How We Didn't Get to the Moon." *Izvestiya*. 18 August 1989, pp. 130-135. Translated by David Doughan. This is an important official statement from Russian officials on the details of the previously secret Soviet race to the Moon conducted in the 1960s. It describes the work of Sergei Korolev

and other designers to build the N-1 booster, the difficulties with the program, and its cancellation after the U.S. success with Apollo 11.

Logsdon, John M., and Dupas, Alain. "Was the Race to the Moon Real?" *Scientific American*. 270 (June 1994): 36-43. One of the better discussions, although not written with scholarly apparatus, of the race between the United States and the Soviet Union to the Moon in the 1960s. The answer to the question in the title, the authors contend, is a resounding yes. Using recently available Soviet documents, they find that the Soviets made several secret attempts to develop hardware for a lunar landing that would beat the U.S. to the Moon. That they were unsuccessful in doing so resulted from "personal rivalries, shifting political alliances and bureaucratic inefficiencies." These "bred failure and delays within the Soviet lunar-landing program." The Americans were successful, on the other hand, because they enjoyed "consistently strong political and public support."

McDougall, Walter A. ...*The Heavens and the Earth: A Political History of the Space Age*. New York: Basic Books, 1985. This Pulitzer Prize-winning book analyzes the space race to the Moon in the 1960s. The author, then teaching at the University of California, Berkeley, argues that Apollo prompted the space program to become identified almost exclusively with high-profile, expensive, human space flight projects. This was because Apollo became a race against the Soviet Union for recognition as the world leader in science and technology, and by extension in other fields as well. McDougall juxtaposes the American effort of Apollo with the Soviet space program and the dreams of such designers as Sergei P. Korolev to land a Soviet cosmonaut on the Moon. The author recognizes Apollo as a significant engineering achievement but concludes that it was also enormously costly both in terms of resources and the direction to be taken in state support of science and technology.

\_\_\_\_\_. "Technocracy and Statecraft in the Space Age: Toward the History of a Saltation." *American Historical Review*. 87 (1982): 1010-40. This well-written article in the premier historical journal of the United States places the space race in the context, initially, of World War II and then the Cold War. The author argues that because of "Apollo, the space program came to stress engineering over science, competition over cooperation, civilian over military management, and prestige over practical applications." He calls Apollo a "magnificent achievement" but notes that by "1963-64 left-liberal critics denounced" it "as wasteful given problems of racism and poverty." Much more an assessment of the effect of space upon American society than a history of developments in space, this wide-ranging essay concludes that the space race transformed the state into a "promoter of technological progress." Implicit in the analysis is the author's doubt that this was beneficial.

Mallove, Eugene F. "Once Upon a Moon Race." *Ad Astra*. February 1990, pp. 14-18. This is a straightforward piece of reporting about six U.S. university professors who visited Russia and viewed what was left of the hardware developed for the Soviet lunar program. The article emphasizes the importance of the race between the U.S. and the Soviet Union in the 1960s.

Mishin, Vasili. "The Moon Programme That Faltered." *Spaceflight*. 33 (March 1991): 2-3. This short article is most important because it represents an essentially official Russian statement, by one of the key members of the S.P. Korolev-led design bureau that was working on a lunar landing program. It describes the efforts to beat the U.S. to the Moon and admits that the plan failed and was therefore denied for more than twenty years.

\_\_\_\_\_. "The Role of Academician S.P. Korolev in the Development of Space Rocket Vehicles for the Lunar Exploration with the Help of Manned Spaceships." IAA-91-674 paper, delivered at the 42d Congress of the International Astronautical Federation, Montreal, Canada, 5-11 October 1991. Copy available in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. This paper, written by one of the senior assistants of Sergei Korolev in the 1960s, presents a detailed examination of the work of Korolev's design bureau on Soviet hardware for use in a lunar exploration program.

Newkirk, Dennis. "More Data on the Soviet Manned Lunar Program." *Quest: The History of Spaceflight Magazine*. 2 (Summer 1993): 32-35. This is a heavily-illustrated article on details of the Soviet N-1 "Moon Rocket" built in the late 1960s.

Oberg, James E. "The Moon Race (and the Coverup) in Hindsight." *Spaceflight*. 35 (February 1993): 46-47. Since the Russians admitted only twenty years after the fact that they were indeed involved in a serious race to the Moon with the United States, Oberg has collected several statements from leaders in the West who believed the Soviet Union's claims at the time that it was not involved in a lunar program. In the process, he comments that bad guesses, Soviet lies, and naive assumptions led them to accept Soviet denials. There are quotations from several major newspapers, politicians such as Senator J. William Fulbright, journalists such as Walter Cronkite and John Nobel Wilford, and academics like William Schauer and Richard Hutton.

\_\_\_\_\_. *Red Star in Orbit*. New York: Random House, 1981. Written by one of the premier Soviet space watchers, this history of the Soviet space program is among the best published in English prior to the fall of the Soviet Union in 1989. Based on mostly western sources, it describes what was then known of the Soviet Union's efforts to land a cosmonaut on the Moon before the U.S. Apollo landing in 1969.

\_\_\_\_\_. "Russia Meant to Win the 'Moon Race.'" *Spaceflight*. 17 (May 1975): 163-171, 200. An early argument, based on semi-official Soviet statements, that the Soviet Union did try to reach the Moon before the United States.

\_\_\_\_\_. "Yes, There was a Moon Race." *Air Force Magazine*. 73 (April 1990): 92-97. This article examines recently revealed evidence confirming that the Soviet Union did seek to reach the Moon before the United States during the 1960s. A Soviet uncrewed lunar probe crashed on the Moon's surface shortly before the landing by the U.S. during Apollo 11. The article discusses this event and numerous other details of schedules for lunar exploration, Soviet lunar boosters and landers, the technical problems the Soviets faced, continuous changes in their goals, and much else, showing clearly the extent of the competition with the U.S. program.

Petrov, G.I. Editor. *Conquest of Outer Space in the USSR*. New Delhi: Amerind Pub. Co., 1973. Translated from the Russian and published for the National Aeronautics and Space Administration and the National Science Foundation. This book is a collection of official announcements issued by Tass and material published in the Soviet press from October 1967 to 1970. It is silent on the possibility of a lunar landing program.

Riabchikov, Evgeny. *Russians in Space*. Garden City, NY: Doubleday and Co., 1971. Translated by Guy Daniels. This is a translation of a Novosti Press, Moscow, publication that recounts the history of the Soviet space program as it was publicly acknowledged by the Soviet leadership. There is virtually no discussion of a lunar landing program by the Soviets, it not being an officially-acknowledged program at the time, but there is considerable description of the development of rockets and the activities of cosmonauts in space.

Shklovskii, Iosif. *Five Billion Vodka Bottles to the Moon; Tales of a Soviet Scientist*. New York: W.W. Norton and Co., 1991. An enlightening memoir of Soviet space science during the Cold War era. Written with charm and wit.

Smolder, Peter. *Soviets in Space*. New York: Taplinger Pub. Co., 1971. Based on Russian-language technical information and western sources, this journalistic account of the Soviet space program describes the broad base of activities by the Soviet Union in space through the 1960s. The author concentrates on the activities of the cosmonauts but does not discuss at length the possibility of a lunar landing program. He does, however, discuss the American reaction to Soviet space successes in announcing the Apollo program.

- Stoiko, Michael. *Soviet Rocketry: Past, Present, and Future*. New York: Holt, Rinehart and Winston, 1970. The author, an expert on rocket technology, provides in this book a popular discussion of Soviet space technology, and by implication the development of the Russian space program. Beginning with Sputnik 1, Stoiko traces the development of the various major boosters used in the Soviet space program, as well as the spacecraft development and the launch facilities built.
- Stroup, T.L., and Allen, R.D. "Early Lunar Base Concepts: The Lockheed Experience, Part 1." Paper IAA-92-0190, Presented at the 43rd Congress of the International Astronautical Federation. Washington, DC, 1992. This is an interesting analysis of plans developed at Lockheed in the 1960s for the permanent colonization of the Moon. One of the uses advanced for such colonization was to support Cold War efforts against the Soviet Union.
- Vick, Charles P., and DeMeis, Richard. "The Soviet Race to the Moon." *Aerospace America*. November 1990, pp. 22-25. Another of the popular discussions of the Soviet lunar landing program that uses post-Cold War information to describe the details of the unsuccessful Soviet effort to beat the Americans to the Moon in the 1960s.
- Vladimirov, Leonid. *The Russian Space Bluff: The Inside Story of the Soviet Drive to the Moon*. New York: Dial Press, 1973. Translated by David Floyd. In the aftermath of the American success with Apollo 11 to land astronauts on the Moon, this book describes how far behind the Soviet Union truly was in the development of space technology. The author, a Soviet defector who was both a journalist and a student of engineering, contends that the Soviet Union was involved in a secret effort to beat the Americans to the Moon and would have used the success as another means of demonstrating the superiority of the communist system over the capitalism of the West. They had done so with Sputnik in 1957 and the Gagarin flight in 1961—both of which had been secret efforts announced only after they had been successful—and they would have done so again. But the author contends that the Soviet scientific and industrial complex was insufficient to best the Americans and when Apollo 11 was completed, the Soviets quietly dropped their plans for a lunar landing program.
- Young, Hugo; Silcock, Bryan; and Dunn, Peter. "From the Bay of Pigs to the Sea of Tranquility: Why We Went to the Moon." *The Washington Monthly*. April 1970, pp. 28-58. This is a lengthy article castigating the entire space program for wasting billions of dollars on Project Apollo so that contractors could acquire greater wealth, government bureaucrats could enhance "turf," and Congressmen could have more "pork barrel" opportunities.
- Young, Steven. "Soviet Union was Far Behind in 1960's Moon Race." *Spaceflight*. 32 (January 1990): 2-3. This is a linear discussion of the development of the Soviet lunar spacecraft emphasizing the difficulties of the program.

## CHAPTER 3

# DECISION

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Ad Hoc Committee on Space (Jerome B. Wiesner, Chair), "Report to the President-Elect of the Ad Hoc Committee on Space," 10 January 1961. Available in the NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. John F. Kennedy was the first president-elect to set up high-level "transition teams" to advise him on issues that he would face upon assuming the presidency. This is one of 29 task forces that studied national policy for the president-elect. Chaired by Massachusetts Institute of Technology Professor Jerome Wiesner, a member of President Eisenhower's President's Science Advisory Committee (and thus familiar with discussions inside the Eisenhower administration on space policy and programs), this report was very critical of the management of the human space flight program and urged Kennedy to distance himself from potential failures. It asserted that the U.S. holds "a position of leadership in space sciences," but not in piloted space flight, which the committee nonetheless holds to be inevitable for "the same motives that have compelled [man] to travel to the poles and to climb the highest mountains of the earth." It specifically suggested shying away from an aggressive project such as Apollo.

Divine, Robert A. "Lyndon B. Johnson and the Politics of Space." In *The Johnson Years: Vietnam, The Environment, and Science*. Lawrence: University Press of Kansas, 1987. Pp. 217-53. This excellent article traces the political leadership of Senator-Vice President-President Johnson concerning the space program from the Sputnik crisis of 1957 through January 1969. It emphasizes the role he played as chair of the National Aeronautics and Space Council in 1961 in investigating the option for the United States in Space and presenting to the president a well-crafted decision-package in favor of the Apollo commitment. It emphasizes his political acumen and ability to construct a coalition of interests supporting the lunar landing.

Dryden, Hugh L. "The Exploration of Space." Cosmos Club Lecture, 13 April 1959. Copy in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. The nation's post World War II scientific elite, nurtured by the unprecedented federal investment in scientific research during the war, had as its Washington gathering place the Cosmos Club, located in one of the elegant Renaissance revival mansions that line Massachusetts Avenue. NASA Deputy Administrator Hugh L. Dryden, who had spent most of his career at the National Bureau of Standards before his appointment in 1947 as Director of Research of the National Advisory Committee for Aeronautics (NACA), was a Cosmos Club member and had served a term as its president. The Club was a fitting location for a lecture that laid out in some detail the broad agenda of space science and exploration envisioned for NASA in 1959. Interestingly, Dryden's view of NASA's long range objectives projected an orbiting space station as a prerequisite for the first human journey to the Moon.

\_\_\_\_\_. "Exploring the New Frontiers of Space." An address to the Western Space Age Conference, Los Angeles, California, 5 March 1959. Copy in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. Very similar to Dryden's Cosmos Club speech, this address sets out NASA's "inevitable" long-range plan and compares it to other exploits of discovery. He calls for human exploration of the Moon.

\_\_\_\_\_. "The Next Fifty Years." *Aero Digest*. July 1953. In this article, the author, Director of the NACA wrote: "If there is any Twentieth Century aspiration which corresponds to that of the Nineteenth Century for the conquest of the air, it is perhaps that of the conquest of space with the early goal, travel to the moon. Like the conquest of flight during the Nineteenth Century, these concepts of space travel are the results of imaginative men to apply the technology of their day to the problem of interplanetary flight."

- \_\_\_\_\_. "Space Technology and the NACA." An address to the Institute of the Aeronautical Sciences, New York, NY, January 27, 1958. Copy in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. In this speech Dryden forecasts the long-range goal as "development of manned satellites and the travel of man to the moon and nearby planets."
- Hechler, Ken. *Toward the Endless Frontier: History of the Committee on Science and Technology, 1959-1979*. Washington, DC: U.S. House of Representatives, 1980. Contains the best account to date of Congressional wrangling over Project Apollo and demonstrates the bipartisan nature of both Apollo support and opposition.
- Holmes, Jay. *America on the Moon: The Enterprise of the Sixties*. Philadelphia: J.B. Lippincott, 1962. A journalistic account of the early history of Project Apollo, this book also has a lengthy discussion of the Kennedy commitment to begin an accelerated lunar landing program to beat the Soviets to the Moon and demonstrate U.S. technological superiority.
- Logsdon, John M. *The Apollo Decision and its Lessons for Policy-Makers*. Washington, DC: Program of Policy Studies in Science and Technology Occasional Paper no. 7, George Washington University, 1970. This study is an analysis of what the author considers rational policy-making in a national context. Logsdon describes the major events of the period between Kennedy's election and the 25 May 1961 announcement of the Apollo goal. He concludes that the Apollo commitment was made only after a lengthy decision-making process in which alternatives were rationally considered and political consensus reached.
- \_\_\_\_\_. "An Apollo Perspective." *Astronautics & Aeronautics*. 17 (December 1979): 112-16. This brief article analyzes the situation facing the U. S. space program in 1979 in the light of Apollo and concludes that the base of support for a major national investment in space, such as the one that existed for Apollo in 1961 simply did not exist 18 years later and was unlikely to emerge again for a considerable time in the future. Logsdon noted that for Kennedy the Moon landing program, conducted in the tense Cold War environment of the early 1960s, was a strategic decision directed toward advancing the far-flung interests of the United States in the international arena. It aimed toward recapturing the prestige that the nation had lost as a result of Soviet successes and U.S. failures. Like most political decisions, at least in the U.S. experience, the decision to carry out Project Apollo was an effort to deal with an unsatisfactory situation (world perception of Soviet leadership in space and technology). As such Apollo was a remedial action ministering to a variety of political and emotional needs floating in the ether of world opinion. According to Logsdon, Apollo addressed these problems very well and was a worthwhile program if measured only in those terms. In announcing Project Apollo Kennedy put the world on notice that the U.S. would not take a back seat to its superpower rival. Logsdon concluded: "By entering the race with such a visible and dramatic commitment, the United States effectively undercut Soviet space spectaculars without doing much except announcing its intention to join the contest" (p. 115).
- \_\_\_\_\_, et al. *Apollo in its Historical Context*. Washington, DC: The George Washington University Space Policy Institute, 1990. This edited version of remarks presented at a 1989 symposium includes articles by Logsdon on "Evaluating Apollo"; Walter A. McDougall on "Apollo and Technocracy"; Daniel J. Boorstin on "The Rise of Public Discovery"; and Frank White on "Apollo in a Millennial Perspective." Concludes with a discussion based on questions from the audience at the symposium. Useful for the perspectives offered by the four eminent participants.
- \_\_\_\_\_. *The Decision to Go to the Moon: Project Apollo and the National Interest*. Cambridge, MA: The MIT Press, 1970. This book describes in detail the political issue of how the United States decided to go to the Moon in 1961. Logsdon pulls together most of the publicly available data and commentary on the events surrounding President Kennedy's May 1961 announcement committing the United States to an accelerated lunar landing program. The author touts the decision to press Project Apollo as the political process at its

best. It was consensus-building and consensus-maintaining, and finally accomplishment of the ideal. While the detailed discussion of how all this took place is exemplary, this conclusion is questionable. The more interesting question is how could Apollo have been decided and carried out while the political process was unable to reach agreement and carry out objectives on a broad range of other federal priorities ranging from urban decay and crime to health care and economic recession?

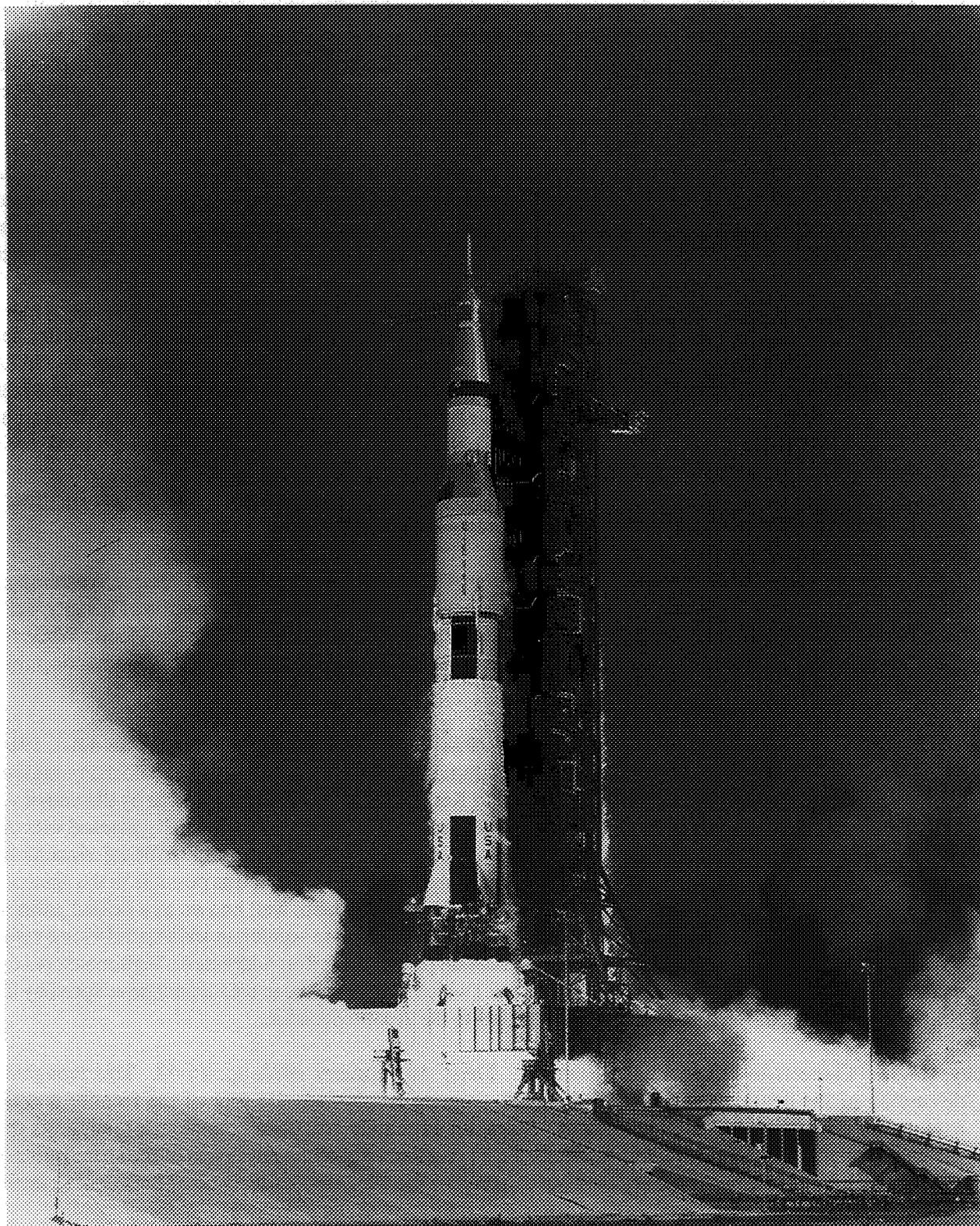
\_\_\_\_\_. "The Policy Process and Large-Scale Space Efforts." *Space Humanization Series*. Institute for the Social Science Study of Space, 1979. This study reviews the other Apollo and Space Shuttle decisions, largely rehashing other work by the author, and concludes that large-scale technological endeavors can be undertaken in the public arena only by winning the support of a wide range of political groups, each supporting the effort for different reasons.

NASA Office of Program Planning and Evaluation. "The Long Range Plan of the National Aeronautics and Space Administration," NASA Headquarters, Washington, DC, 16 December 1959. Copy in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. This initial ten-year plan for NASA was developed during the agency's first year of operation, and although issued by NASA headquarters it did not become official U.S. government policy. Because it contained both target dates for various accomplishments and budget estimates for the decade, it received a "Secret" security classification and was later declassified. For the development of Project Apollo, the plan is significant because it advocated a human flight to the Moon only sometime after 1970.

President's Science Advisory Committee (James R. Killian, Chair). *Introduction to Outer Space*. Washington, DC: The White House, 26 March 1958. This short brochure contains the best description of Eisenhower's "alternative" space program to what had been advocated by those wanting to land on the Moon. While the report stresses scientific goals in space, it nonetheless is unable to frame an alternative to the romantic public interest in lunar and planetary exploration.

Rosholt, Robert L. *An Administrative History of NASA, 1958-1963*. Washington, DC: NASA SP-4101, 1966. This history contains a detailed discussion of the internal NASA efforts to support the decision-making process among senior government officials that led to Kennedy's lunar landing objective by the end of the 1960s. It presents an interpretation suggesting that while NASA's leaders were generally pleased with the course Kennedy chose with Apollo—they recognized and mostly agreed with the political reasons for adopting an aggressive lunar landing program—they wanted to shape it as much as possible to the agency's particular priorities. It shows that NASA Administrator James E. Webb, well known as a skilled political operator who could seize an opportunity, organized a short-term effort to accelerate and expand a long-range NASA master plan for space exploration. A fundamental part of this effort addressed a legitimate concern that the scientific and technological advancements for which NASA had been created not be eclipsed by the political necessities of international rivalries that led to the Apollo decision.

Sidey, Hugh. "Pioneers in Love with the Frontier." *Time*. 10 February 1986, pp. 46-47. This thoughtful discussion of the development of the U.S. space program emphasizes the role of the frontier and the exploration imperative in the United States. Sidey, an extremely articulate commentator, suggests that nothing worthwhile is gained without sacrifice. This was a response to the naysayers of the space program after the January 1986 Challenger accident but emphasizes the 1961 Apollo decision of President Kennedy as the quintessential statement of a vision favoring exploration of the unknown.



*The Apollo/Saturn V space vehicle carrying the Apollo 11 astronauts as it lifts off, 9:32 a.m. EDT on July 16, 1969. NASA photo 69-H-1124.*

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# CHAPTER 4

## ***APOLLO TECHNOLOGY***

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Akens, David S. *Saturn Illustrated Chronology*. Huntsville, AL: Historical Office, George C. Marshall Space Flight Center, 1971. Covering the period April 1957-April 1968, this fifth edition of the chronology contains numerous photos and a more or less blow-by-blow account of the design and development of the Saturn launch vehicle family. It includes a useful glossary, a 528-item bibliography of specialized sources, and an index. The Marshall History Office also began in 1960 preparing annual histories and later, chronologies, of the center, which also contain much information on the design and development of Saturn.

“Apollo 11 Television Cameras.” *Optical Spectra*. 3 (September/October 1969): 65-69. One of several articles in this issue dealing with the Apollo program, this particular account focuses on the television cameras used in the command module and on the Moon’s surface. It discusses their technical features and possible future applications.

Arabian, D.D. “Action on Mission Evaluation and Flight Anomalies.” *Astronautics and Aeronautics*. 8 (March 1970): 72-75. Arabian, chief of the Apollo program’s test division, explains how specialists at the Manned Spacecraft Center resolved anomalies that they identified in Apollo equipment.

Baker, David. “Apollo Hardware: Inventory and Disposition.” *Spaceflight*, 16 (April 1974): 137-39. A listing of spacecraft, launchers, and other Apollo hardware with information about location of some of the items.

\_\_\_\_\_. “The Apollo Service Propulsion System.” *Spaceflight*. 11 (August 1969): 287-90. A technical discussion of the propulsion system for the command and service module.

\_\_\_\_\_. “The Apollo Spacecraft: Guidance and Navigation.” *Spaceflight*. 11 (November 1969): 386-89. An extremely technical discussion of the complex guidance and navigation systems for Apollo spacecraft through Apollo 11.

\_\_\_\_\_. “Lunar Roving Vehicle: Design Report.” *Spaceflight*. 13 (July 1971): 234-40. A detailed but comprehensible account of the design and development of the lunar rover, written before its initial deployment on Apollo 15.

Bilstein, Roger E. *Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles*. Washington, DC: National Aeronautics and Space Administration SP-4206, 1980. This thorough and well-written book gives a detailed but highly readable account of the enormously complex process whereby the Marshall Space Flight Center under the direction of Wernher von Braun developed the launch vehicles used in the Apollo program ultimately to send twelve humans to the Moon. Based on exhaustive research and equipped with extensive bibliographic references, this book comes as close to being a definitive history of the Saturn rocket program as is ever likely to appear. Moreover, it is not simply a technical history but covers the decision-making process that lay behind the technological development, making it not just a history of hardware development but also an analysis of technical management and organization. As one reviewer said in *Air University Review*, “This volume is just one of many excellent histories produced by government and contract historians for the NASA History Office....The book is enhanced by many excellent appendixes and charts, and it has a thorough essay on sources and documentation....Author Roger Bilstein...gracefully wends his way through a maze of technical documentation to reveal the important themes of his story; rarely has such a nuts-and-bolts tale been so gracefully told.”

- \_\_\_\_\_. "From the S-IV to the S-IVB: The Evolution of a Rocket Stage for Space Exploration." *Journal of the British Interplanetary Society*. 32 (December 1979): 452-8. This article explores the evolution of the S-IVB stage used in the Saturn IB and Saturn V launch vehicles. Noting that the liquid-hydrogen fuel for this stage "presented unique design challenges," Bilstein shows that although the earlier S-IV and its successor, the S-IVB "were developed and built by two different contractors," NASA arranged for the information from the one to be available for the development of the other, helping to ensure the success of the Apollo mission. This detailed but readable article also shows the debts of both stages to previous designs for space and missile systems such as Thor.
- Boeing Company. *Apollo/Saturn V Roll of Honor*. Seattle, WA: The Boeing Co., 1970. This rare book, filled with photos and diagrams, covers every aspect of Boeing's manufacturing, assembly, and testing at the Michoud Plant in Louisiana of the first stage (S-IC) of the Saturn V rocket. It also covers Boeing's activities at NASA's Marshall, Kennedy, and Manned Space Flight centers as well as its involvement in Apollo technical integration at NASA Headquarters in Washington, DC. The "roll of honor" reference in the title refers to a 174-page collection of short biographical sketches of Boeing personnel involved in the Apollo program. There is also a list of associate contractors at the end of the thick, large-format volume, a copy of which is available in the rare book collection of the Library of Congress and another in the NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC.
- Bond, Aleck C., and Faget, M[axime Allen]. *Technologies of Manned Space Systems*. New York: Gordon and Breach, 1965. A useful early description of the Mercury, Gemini, and Apollo systems.
- Boynton, John H., and Kleinknecht, Kenneth S. "Systems Design Experience from Three Manned Space Programs." *Journal of Spacecraft and Rockets*. 7 (July 1970): 770-84. Two managers at the Manned Spacecraft Center summarize the systems design experience for Mercury, Gemini, and Apollo. 77 bibliographic notes.
- Brooks, Courtney G., and Ertel, Ivan D. *The Apollo Spacecraft: A Chronology, Volume III, October 1, 1964-January 20, 1966*. Washington, DC: NASA SP-4009, 1973. This volume in the series (see below for volume 1 under Ertel) covers primarily the detailed engineering of the three spacecraft being manufactured by North American and Grumman—the command and service and the lunar excursion modules.
- Brooks, Courtney G.; Grimwood, James M.; and Swenson, Loyd S., Jr. *Chariots for Apollo: A History of Manned Lunar Spacecraft*. Washington: National Aeronautics and Space Administration SP-4205, 1979. The authors of this book describe it accurately in their preface (p. xiv) as beginning "with the creation of NASA itself and with the definition of a manned space flight program to follow Mercury. It ends with Apollo 11, when America attained its goal of the 1960s, landing the first men on the moon and returning them to the earth. The focal points of this story are the spacecraft—the command and service modules and the lunar module." Based on exhaustive documentary and secondary research as well as 341 interviews, this well-written volume covers the design, development, testing, evaluation, and operational use of the Apollo spacecraft through July 1969.
- Dooling, Dave. "The Evolution of the Apollo Spacecraft, Part 1," *Spaceflight*, 16 (March 1974): 82-88. An account of the background discussions and activities leading up to the development of the Apollo hardware in the 1960s.
- \_\_\_\_\_. "The Evolution of the Apollo Spacecraft, Part 2," *Spaceflight*, 16 (April 1974): 127-36. A continuation of the discussion of the design and development of the Apollo hardware in the 1960s, including the decision in favor of the lunar (rather than Earth) orbit rendezvous of the lunar excursion module and the command and service modules following the trip to the Moon.

Ertel, Ivan D., and Morse, Mary Louise. *The Apollo Spacecraft: A Chronology, Volume I, Through November 7, 1962*. Washington, DC: NASA SP-4009, 1969. This chronology actually begins in 1923 with Hermann Oberth's book on rocketry but proceeds rather quickly through the launch of Explorer I with a Jupiter-C in January 1958 to the beginnings of Project Mercury later that year. The bulk of the volume recounts the actual history of the Apollo spacecraft themselves through 7 November 1962 when NASA selected Grumman to develop the lunar excursion module under the direction of the Manned Spacecraft Center. A useful foreword provides context for the remainder of the volume, while a number of appendices add further information in the form of a glossary, tables, and charts.

Ertel, Ivan D.; and Newkirk, Roland W.; with Brooks, Courtney G. *The Apollo Spacecraft: A Chronology, Volume IV, January 21, 1966-July 13, 1974*. Washington, DC: NASA SP-4009, 1978. This volume, organized similarly, carries the story through to the end of the program. It includes all flight tests of the Apollo spacecraft, the last five Gemini flights, the Apollo 204 fire, the follow-on review board activities, the efforts at redefinition that followed its recommendations, and the entirety of the manned Apollo flight program together with its results.

Evanzia, W.J. "A Look at Apollo Electronics." *IEEE Spectrum*. 6 (September 1969): 81-86. A discussion with photos and a map of the electronics devices used on the Mercury, Gemini, and Apollo missions with their spinoff benefits for life on Earth.

Faget, Max[ime Allen]. *Manned Space Flight*. New York: Rinehart and Winston, 1965. This little book by then-assistant director for engineering and development at the Manned Spacecraft Center discusses the technical problems involved in developing manned spacecraft and the elements of science present in engineering solutions. Necessarily technical in places, the book is written in layman's language as much as possible and equipped with photos and diagrams to make it accessible to the general reader.

Gatland, Kenneth W. *Manned Spacecraft*. New York: Macmillan, 1976. Covering Skylab, Apollo-Soyuz, and the Russian space effort as well as Apollo, this little encyclopedia by one of the major popularizers of space's technical side provides a good deal of information and many photographs and diagrams for the interested general reader.

General Motors Corporation. *Apollo 11; guidance and navigation summary: CM software, LM software, ASPO 45 CRT displays, launch and burn schedule*. Milwaukee, WI: AC Electronics Division, 1969. This highly technical publication will be unintelligible to the technically uninitiated reader but contains a wealth of information for those trained in electronic engineering.

"A Golf Cart to Cruise on the Moon." *Life*. 11 June 1971, pp. 70-74. 10 color photos. Very good coverage of the Moon car to be carried on Apollo 15, including testing by the Apollo 15 astronauts.

Heppenheimer, T.A. "Requiem for a Heavyweight." *Air and Space/Smithsonian*. 4 (June-July 1989): 50-55, 59-60. A brief and somewhat popular account of the development of the Saturn V booster with several photos and an illustration of the Saturn V configuration.

Hu, Steve S. Editor. *Saturn V/Apollo and beyond*. Tarzana, CA: American Astronautical Society, 1968. 4 volumes. Also available in the AAS astronautics microfiche series. This compilation publishes the papers presented at the AAS National Meeting, held June 11-14, 1967, at Huntsville, Alabama, cosponsored by the University of Alabama, Marshall Space Flight Center, and United States Army Missile Command. It includes a great variety of papers ranging from one on "The Saturn Instrument Unit" to "The Thermoluminescence of the Moon." Most of the papers are highly technical and equipped with scholarly references. Each is typically accompanied by an abstract and biographical material on the author(s), but there is no table

of contents or index to these four volumes, so they are hard to use without the separate chronological, numerical, and author index to its publications that the AAS later prepared.

- Kleinknecht, Kenneth S. "Design Principles Stressing Simplicity." *Astronautics and Aeronautics*. 8 (March 1970): 46-49. This brief account by the manager for the command and service modules at the Manned Spacecraft Center discusses the principles established to guide engineers designing hardware for the mission.
- Kosloski, Lillian D. *U.S. Space Gear: Outfitting the Astronaut*. Washington, DC: Smithsonian Institution Press, 1993. With more than 150 illustrations, this book describes the development of each component of the space suit from Project Mercury to the Shuttle.
- Kudish, Henry. "The Lunar Rover." *Spaceflight*. 12 (July 1970): 270-74. A brief discussion by the project manager at Boeing of the design of the lunar rover. Easy to understand with a photo and several diagrams.
- Lankes, L.R. "The Role of Optics in the Apollo Program." *Optical Spectra*. 3 (September/October 1969): 39-56. This lengthy account discusses the many optical devices used on the Apollo 11 mission. They included a variety of cameras, lenses, filters, light meters, mirrors, sights, and combinations thereof into sextants and telescopes. This variety of equipment funneled a significant portion of the information obtained from the mission. Somewhat technical in places, for the most part this account is accessible to the lay reader.
- Lay, Bieme. *Earthbound Astronautics: The Builders of Apollo-Saturn*. Englewood Cliffs, NJ: Prentice-Hall, 1971. A breezy and rather superficial account of the government and industry team that designed, managed, and built the Apollo spacecraft. For the general reader rather than the serious researcher except to the extent that it imparts some of the flavor of the enterprise and provides anecdotes, character sketches, and the like.
- Lloyd, Mallon. *Suited up for Space*. New York: John Day, 1971. Details the development of the space suit in Europe and the United States through the full-pressure suits used in Mercury, Gemini, and Apollo.
- "Lunar Roving Vehicle." *Space World*. December 1971, pp. 12-25. As the title suggests, a detailed description with diagrams and photos of the lunar roving vehicle used on Apollo 15.
- Mast, L.T.; Mayer, V.; and Pilnick, C. *Survey of Saturn/Apollo Checkout Automation, Spring 1965; Detailed Description*. Santa Monica, CA: The Rand Corp., 1966. Besides a study of the checkout testing system for the Saturn launch vehicle, this report provides information on stages and launch vehicles, test planning, and programming.
- Morse, Mary Louise, and Bays, Jean Kernahan. *The Apollo Spacecraft: A Chronology, Volume II, November 8, 1962-September 30, 1964*. Washington, DC: NASA SP-4009, 1973. Organized like the previous volume (by Ertel and Morse) in the series, this one covers the period from the conceptual design of the Apollo spacecraft through the formal inspection and review of the so-called Block II command and service module mockup. Included are the reorganization of the Office of Manned Space Flight under George E. Mueller and his appointment of Maj. Gen. Sam Phillips as deputy director and then director of the Apollo program.
- National Aeronautics and Space Administration, Office of Congressional Relations. *Saturn SA-1*. Washington, DC: Office of Congressional Relations, National Aeronautics and Space Administration, n.d. This booklet contains a series of documents and illustrations from 1961, prepared to explain to Congress the impending first launch of the Saturn I (Saturn-Apollo 1) rocket on 27 October 1961. Useful for its specific information about that initial version of the Saturn family of launch vehicles that ultimately carried humans to the Moon.

- Ordway, Frederick Ira, III, and Sharpe, Mitchell R. Foreword by Wernher von Braun. *The Rocket Team*. New York: Crowell, 1979. This popular history by an associate of von Braun who has written widely on space issues and another noted writer about space is devoted almost exclusively to the V-2 rocket with only a few pages providing an overview of the Saturn program.
- Pellegrino, Charles R., and Stoff, Joshua. *Chariots for Apollo: The Making of the Lunar Module*. New York: Atheneum, 1985. A popular and not always accurate discussion of the development of the Lunar Module by Grumman.
- "Project Apollo: The Last Lap." *Spaceflight*. 11 (June 1969): 186-8. A foretaste of Apollo 11 with a description of the lunar module.
- "Project Apollo: The Portable Life Support System." *Spaceflight*. 12 (April 1970): 155-7. Describes the system inside the Apollo space suit that supports life during lunar excursions or extra-vehicular activities.
- Simpkinson, S.H. "Testing to Insure Mission Success." *Astronautics and Aeronautics*. 8 (March 1970): 50-55. Simpkinson, who ran the Apollo spacecraft test program, discusses the testing procedures used to date in the Apollo program, including changes introduced after the Apollo 204 fire. He lists sixteen principles and recommendations resulting from the experience thus far in the program.
- Stachurski, Richard J. "A Look at Apollo Ground Support Control." *Air University Review*. 23 (March-April 1972): 55-67. This article by a junior Air Force officer who served two tours with NASA discusses NASA's ground tracking network in a broad and comprehensible way with a number of photos to illustrate a key element in carrying out the Apollo and other missions into space.
- Stengel, Robert F. "Manual Attitude Control of the Lunar Module." *Journal of Spacecraft and Rockets*. 7 (August 1970): 941-48. An extremely technical description of the way the astronaut-pilot controlled the lunar module. 15 reference notes and 12 figures.
- Swenson, Loyd S., Jr. "On the Mixture of Science and Technology in the Apollo 8 Circumlunar and the Apollo 11 Lunar Landing Missions." *Actes du XIIIe Congres International d'Histoire des Sciences*. 12 (1974): 226-46. These remarks, delivered as a paper at the 13th International Congress of the History of Science in Moscow in 1971, concludes that the Apollo 8 and Apollo 11 missions fit better into the rubric of the history of technology than the history of science, with the latter mission representing a "compromise between scientific and engineering trade-offs" that could hardly satisfy either scientists or engineers. However, the follow-on Apollo missions after the technology had been demonstrated did yield greater scientific returns on the technological investment.
- Tomayko, James E. "Achieving Reliability: The Evolution of Redundancy in American Manned Spacecraft." *Journal of the British Interplanetary Society*. 38 (1985): 545-53. Devoted mainly to the computer systems on the Shuttle, this brief article also discusses the backup systems employed on Gemini and Apollo.
- \_\_\_\_\_. *Computers in Space Flight: The NASA Experience*. NASA Contractor Report 182505, 1988, multilith. Much broader in its coverage than Apollo, this rather technical and conceptually narrow study contains a lengthy chapter on the computers used in the lunar program.
- \_\_\_\_\_. *Computers in Spaceflight: The NASA Experience*, published as volume 18, *Encyclopedia of Computer Science and Technology*, Kent, Allen, and Williams, James G. Editors. New York: Marcel Dekker, Inc., 1987. A published version of the report above.

- \_\_\_\_\_. "Digital Fly-by-Wire: A Case of Bidirectional Technology Transfer." *Aerospace Historian*. 33 (Spring 1986): 10-18. This article deals mostly with post-Apollo technology but does discuss the origins of the fly-by-wire concept in the attitude control devices used for the Mercury, Gemini, and Apollo spacecraft.
- \_\_\_\_\_. "NASA's Manned Spacraft Computers." *Annals of the History of Computing*. 7 (January 1985): 7-18. Argues that contrary to popular belief, NASA has not been at the forefront of computer development except in the areas of fault tolerance and software verification. Elsewhere, NASA has used existing computer technology that has already proved itself, thereby ensuring reliability.
- United States General Accounting Office. *Incentive Provisions of Saturn V Stage Contracts: Report to the Congress on the National Aeronautics and Space Administration*. Washington, DC: General Accounting Office, 1970. A detailed report discussing NASA's \$26.2 million in schedule incentives written into contracts for the S-IC and S-IVB Saturn V stages. GAO believed the incentives were unnecessary but NASA argued that they reduced costs, permitted mission adjustments, and kept the program costs at the minimum obtainable.
- United States General Accounting Office. *Overstatement of Contract Target Cost for First Stage of Saturn V Launch Vehicle: Report to the Congress on the National Aeronautics and Space Administration*. Washington, DC: General Accounting Office, 1970. This short report concludes that Boeing overcharged NASA for the first stage of the Saturn V launch vehicle by about \$695,000. Boeing disagreed.
- United States General Accounting Office. *Overstatement of Contract Target Costs for F-1 Rocket Engines for Saturn V Launch Vehicle: Report to the Congress on the National Aeronautics and Space Administration*. Washington, DC: General Accounting Office, 1970. A detailed report claiming that North American Rockwell overcharged NASA by \$6.5 million for the Saturn V's F-1 engine. North American disagreed generally with the findings.
- United States General Accounting Office. *Review of the Saturn S-IVB-503 stage accident under the Apollo Program; Report to the Congress on the National Aeronautics and Space Administration*. Washington, DC: General Accounting Office, 1969. A report on the acceptance test firing of the S-IVB-503 stage of the Saturn launch vehicle, in which the stage exploded and was destroyed, it estimates costs of \$13.3 million for the accident. The report concluded that if McDonnell Douglas Corporation and its subcontractors had followed established quality assurance procedures, there probably would have been no accident.
- United States House, Committee on Science and Astronautics, Subcommittee on NASA Oversight. *Investigation into Apollo 204 accident, Hearings, Ninetieth Congress, first session*. Washington, DC: Govt. Print. Off., 1967. This 3-volume committee print contains testimony, a summary of actions taken on the findings and determinations of the accident review board, the report of that board itself, and a report on the principal new features of the new (Block II) command and service module as compared with the one involved in the accident (Block I), together with a description of the testing planned to validate the changes made.
- Widnall, William S. "Lunar Module Digital Autopilot." *Journal of Spacecraft and Rockets*. 8 (January 1971): 56-67. A highly technical discussion of the autopilot system on the lunar module. 16 reference notes and 10 figures.
- Williamson, Mark. "Engineering the Lunar Module." *Space*. 7 (1 May 1991): 20. The author retraces how Grumman fought to keep the weight of the Apollo Lunar Module down while maintaining the project on schedule.

# CHAPTER 5

## OPERATIONS

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### GENERAL

Alter, Dinsmore. Editor. *Pictorial Guide to the Moon*. 3d edition. New York: Thomas Y. Crowell Co., 1973. A general work using imagery and information from Project Apollo for its presentation.

Beeler, Mary, and Michlovitz, K. *Lunar Orbiter Photographic Data: Data Users' Note*. Greenbelt, MD: National Space Science Data Center, 1969. This volume announces the availability of lunar orbiter pictorial data and seeks to help users select photographs for study. Purely a reference tool with charts showing locations of the photographic coverage by mission.

Benson, Charles D. and Faherty, William Barnaby. *Moonport: A History of Apollo Launch Facilities and Operations*. Washington, DC: NASA SP-4204, 1978. An excellent history of the design and construction of the lunar launch facilities at Kennedy Space Center. Of *Moonport*, a reviewer in the *Journal of American History* said in 1979, "The authors had access to official documents, letters, and memoranda, and they have apparently consulted all the relevant historical, technological, and scientific secondary materials...; all the involved historians obviously spent considerable time studying and intellectually digesting technical reports and manuals in order to give their lay readers such lucid accounts of highly complex procedures and operations...; it is important to public knowledge to have professionally trained historians employ historical methods to explain significant events and place them in a meaningful historical context. Here is a broad lesson...that contemporary society can ill afford to ignore."

Bowker, David E. and Hughes, J. Kenrick. *Lunar Orbiter Photographic Atlas of the Moon*. Washington, DC: NASA SP-206, 1971. This is an atlas of the photographs returned from five spacecraft put into lunar orbit from 1966 to 1967 in the effort to determine the nature of the lunar surface so astronauts could land there. These photographs cover "landing sites and specific areas of high scientific interest." This volume contains 675 plates along with their photo numbers, plus indexes and maps showing the locations on the Moon that the photos depict.

Brooks, Courtney G., Grimwood, James M., and Swenson, Loyd S., Jr. *Chariots for Apollo: A History of Manned Lunar Spacecraft*. Washington: NASA SP-4205, 1979. The authors of this book describe it accurately in their preface (p. xiv) as beginning "with the creation of NASA itself and with the definition of a manned space flight program to follow Mercury. It ends with Apollo 11, when America attained its goal of the 1960s, landing the first men on the moon and returning them to the earth. The focal points of this story are the spacecraft—the command and service modules and the lunar module." Based on exhaustive documentary and secondary research as well as 341 interviews, this well-written volume covers the design, development, testing, evaluation, and operational use of the Apollo spacecraft through July 1969. As such, it brings the story to its mid-way point, where it is taken up by the Compton book described below.

Byers, Bruce K. *Destination Moon: A History of the Lunar Orbiter Program*. Washington, DC: NASA TM X-3478, 1977. This study discusses the origins of the lunar orbiter program and covers the lunar orbiting missions from 1963-1970 when they collected photographic and selenodetic data in support of NASA missions to the Moon.

Compton, W. David. *Where No Man Has Gone Before: A History of Apollo Lunar Exploration Missions*. Washington, DC: NASA SP-4214, 1989. This clearly-written account traces the ways in which scientists with interests in the Moon and engineers concerned with landing people on the Earth's satellite resolved their differences of approach and carried out a mission that made major contributions to science and developed remarkable engineering achievements. Roughly half of the volume is devoted to preparations for the lunar landings, with the remainder of the book detailing the lunar explorations that followed Apollo 11, in which twelve astronauts visited the Moon and brought back lunar samples for scientists to investigate.

Disher, John H. "Space Transportation: Reflections and Projections." In Durant, Frederick C., III, editor. *Between Sputnik and the Shuttle: New Perspectives on American Astronautics*. San Diego, CA: American Astronautical Society, 1981. pp. 199-224. This article is part of a larger publication focusing on various aspects of the space program. A presentation by the director of advanced programs for NASA's office of space transportation systems at the AAS, it contains no notes or other scholarly apparatus. It does survey the methods of spaceflight for piloted missions since Mercury.

Gutschewski, Gary L.; Kinsler, Danny C.; Whitaker, Ewen. *Atlas and Gazetteer of the Near Side of the Moon*. Washington, DC: NASA SP-241, 1971. This reference work consists of 404 photographs from Lunar Orbiter IV of the near side of the Moon, accompanied by alphabetical guides to specific lunar features and five indices of lunar names.

Hall, R. Cargill. *Lunar Impact: A History of Project Ranger*. Washington, DC: NASA SP-4210, 1977. This is a thorough and readable history of the project to photograph the lunar surface from its initial failures to its ultimate successes. In the process of recounting them, the author has analyzed the transformations in the project, the institutions, and the people involved in it that led from the one to the other.

\_\_\_\_\_. *Project Ranger: A Chronology*. Pasadena, CA: JPL/HR-2, 1971. A companion piece to the history above, this publication provides an almost day-by-day account of the evolution of the project.

Hyatt, Abraham. "Stranded in Lunar Orbit." *Astronautics and Aeronautics*. 7 (March 1969): 72-80. The scenario for what would happen during the Cold War if humans were stranded on the Moon. Would the U.S. and the U.S.S.R. cooperate to save him? A short play characterizes the imagined rescue.

Jet Propulsion Laboratory. *Ranger VI Photographs of the Moon*. Washington, DC: NASA SP-61, 1964. Some 199 photos of the Moon taken by Ranger VII in 1964 together with related reference material.

\_\_\_\_\_. *Ranger IX Photographs of the Moon*. Washington, DC: NASA SP-112, 1966. Contains 170 photos of the Moon taken by Ranger IX in 1965 plus related reference material.

Kosofsky, L. J. and El-Baz, Farouk. *The Moon as Viewed by Lunar Orbiter*. Washington, DC: NASA SP-200, 1970. "This book includes selected parts of Lunar Orbiter photographs that illustrate some salient features of the lunar surface," as the book's preface states, with more complete coverage provided by Bowker and Hughes' *Lunar Orbiter Photographic Atlas of the Moon*, discussed above.

Kranz, Eugene F., and Covington, James O. "Flight Control in the Apollo Program." *Astronautics and Aeronautics*. 8 (March 1970): 64-71. This account by two leading officials at the Manned Spacecraft Center in Houston covers the Apollo flight control program through Apollo 12 in clear language with some complicated diagrams to illustrate technical points.

McKee, Daniel D. "The Gemini Program." *Air University Review*. 16 (May-June 1965): 6-15. This article by an Air Force officer assigned to NASA's Manned Spacecraft Center discusses the differences between Mercury and Gemini and the relevance of Gemini to Air Force goals. The author emphasizes that the Air

Force was making “every effort . . . to derive the maximum military benefit from the NASA Gemini program.”

Musgrove, Robert G. *Lunar Photographs from Apollos 8, 10, and 11*. Washington, DC: NASA SP-246, 1971. As the title suggests, this is a series of captioned photographs from the three missions, followed by indexes.

North, Warren J., and Woodling, Carroll H. “Apollo Crew Procedures, Simulation and Flight Planning.” *Astronautics and Aeronautics*. 8 (March 1970): 56-62. This article by two managers at the Manned Spacecraft Center discusses how “a broad range of activities, centered on simulators, brought crews to a state of readiness and honed flight plans and procedures.”

*The Times Atlas of the Moon*. Edinburgh, Scotland: John Bartholomew & Son, 1970. This reference work is a large-size, full-color effort to document the features of the Moon’s surface. Based almost entirely on U.S. sources, it has 110 full-color maps and many more photographs to illustrate the book.

Tindall, H. W., Jr. “Techniques of Controlling the Trajectory.” *Astronautics and Aeronautics*. 8 (March 1970): 76-82. This account by an official at the Manned Spacecraft Center discusses “how the various components of the guidance, navigation, and control systems (GNC) and, to some extent the engines are to be used during all phases of the manned Apollo missions.”

## **APOLLO 204 FIRE**

(Apollo Accident Report). *Aviation Week and Space Technology*. 6 February 1967, pp. 29-36; 13 February 1967, pp. 33-36; and 20 February 1967, pp. 22-23. Discusses the ways NASA was attempting to maintain its Apollo landing schedule despite the Apollo 204 accident. Also covers congressional monitoring of the accident investigation and the inquiry itself. Not a conclusive discussion, since the investigation had not yet ended as of 20 February, but it gives something of the flavor and immediacy of the situation in NASA and the country in the wake of the tragedy.

Bergaust, Erik. *Murder on Pad 34*. New York: G.P. Putnam’s Sons, 1968. A highly-critical account of the investigation of the Apollo 204 accident in January 1967 that killed astronauts Gus Grissom, Roger Chaffee, and Edward White. Bergaust takes issue with NASA’s design approach that allowed for the use of a pure oxygen atmosphere in the Apollo command module. It is largely a journalistic rehash of criticism of NASA coming from Congress and the media, with very little new commentary or analysis and no new factual information. Bergaust concludes that the human and fiscal sacrifices made in Project Apollo have been in vain, since the Soviet Union (seen as the reason for Apollo) may not be going to Moon at all.

Biddle, Wayne. “Two Faces of Catastrophe.” *Air and Space/Smithsonian*. 5 (August/September 1990): 46-49. Discusses the different ways in which NASA handled the Apollo 204 fire in 1967 and the Challenger disaster in 1986. Biddle concludes that the comparison shows NASA had become more fragile and lost direction following the Moon landing.

Boyes, W. *Killed Twice Buried Once: A Story about the Catastrophic Apollo Fire*. Rockville, MD: Chesapeake Bay Press, 1986. This “novelized” account of the Apollo 204 fire is, the author claims, “based on the actual events which surrounded” the disaster, but as it contains many fictionalized names and events, it must be consulted with extreme care and only in conjunction with “factual” discussions—or at least ones whose sources are attributed.

“The Capsule Fire Flares Up Again.” *Life*. 17 September 1971, pp. 24-29. 8 B&W photos. Story of the lawsuit brought against North American by Betty Grissom and an engineer’s story of the Apollo 204 disaster.

Gray, Mike. *Angle of Attack: Harrison Storms and the Race to the Moon*. New York: W.W. Norton and Co., 1992. This is a lively journalistic account of the career of Harrison Storms, president of the Aerospace Division of North American Aviation that built the Apollo capsule. Because of the Apollo 204 fire that killed three astronauts in January 1967, Storms and North American Aviation got sucked into a controversy over accountability and responsibility. In the aftermath Storms was removed from responsibility for the project. The most important aspect of this book is its discussion of the Apollo fire and responsibility for it from the perspective of industry. It lays the blame at NASA's feet and argues that Storms and North American were mere scapegoats. It, unfortunately, has no notes and the observations offered cannot be verified.

Kennan, Erlend A., and Harvey, Edmund H., Jr. *Mission to the Moon: A Critical Examination of NASA and the Space Program*. New York: William Morrow and Co., 1969. This book features a detailed examination of the facts of the Apollo 204 fire in January 1967 that killed three astronauts. It does not provide a balanced account of the lunar landing program or NASA. Instead it is filled with critical asides. For example, the authors conclude: "The real reasons for the [Apollo] tragedy—were a lack of perspective and flexibility within NASA management at all key levels; inept, competing, or nonexistent channels of communication throughout the organization's many facilities; lazy, sloppy, and unduly profit-motivated contractor performance, myopic Congressional indulgence (often referred to as 'moon-dogging'), irresponsible public relations—to the point where NASA actually believe its own inflated propaganda; and finally, a remarkable aloofness from and disdain for the legitimate interests of the taxpaying American public." Unfortunately, the treatment is long on hyperbole and short on reasoned analysis; the *New York Times* reviewer said that the book "adds little that is new on any of the problems or possible solutions....But perhaps the book's sense of outrage is in itself an adequate reason for the book's existence."

"The Ten Desperate Minutes." *Life*. 21 April 1967, pp. 113-114. Riveting reconstruction of the events in the ten minutes following the outbreak or fire onboard Apollo 204. Based on eyewitness accounts by pad personnel.

United States House, Committee on Science and Aeronautics. *Apollo and Apollo Applications: Staff Study for the Subcommittee on NASA Oversight of the Committee on Science and Aeronautics, U.S. House of Representatives, Ninetieth Congress, Second Session*. Washington, DC: Government Printing Office, 1968. A brief analysis of the state of the Apollo program in the wake of the Apollo 204 fire followed by four appendices containing documents and abstracts supporting the conclusions of the staff study, which included the judgement: "It appears that NASA and the key industrial contractors are recovering momentum following the Apollo 204 accident and are utilizing the information derived effectively to improve the safety and efficiency of equipment and operations" but that a "number of difficult engineering problems remain to be solved...."

United States House, Committee on Science and Aeronautics. *Apollo Program Pace and Progress; Staff Study for the Subcommittee on NASA Oversight, Ninetieth Congress, First Session*. Washington, DC: Govt. Print. Off., 1967. This thick committee print provides a "summary of the status, completed in December 1966, of the Apollo lunar landing program prior to the tragic" Apollo 204 fire. The introduction and program evaluation occupy only 13 pages, but they are followed by over 1,000 pages of correspondence and transcripts of staff conferences with industrial contractors and NASA center managers in Houston, at Kennedy and Marshall. A summary at the beginning announces it as "the finding of this study that the NASA-industry team is employing its resources effectively in solution of those technical problems which currently pace the program."

United States House, Committee on Science and Aeronautics, Subcommittee on NASA Oversight. *Apollo and Apollo Applications: Staff Study, Ninetieth Congress, Second Session*. Washington, DC: Govt. Print. Off., 1968. This study includes a summary, conclusions, and a brief program analysis followed by correspondence and abstracts of staff conferences with NASA management and industry representatives. The conclusions outline problems and progress since the Apollo 204 fire.

United States House, Committee on Science and Astronautics, Subcommittee on NASA Oversight. *Investigation into Apollo 204 Accident, Hearings, Ninetieth Congress, First Session*. Washington, DC: Govt. Print. Off., 1967. This 3-volume committee print contains testimony, a summary of actions taken on the findings and determinations of the accident review board, the report of that board itself, and a report on the principal new features of the new (Block II) command and service module as compared with the one involved in the accident (Block I), together with a description of the testing planned to validate the changes made.

United States Senate, Committee on Aeronautical and Space Sciences. *Apollo Accident Hearings, Ninetieth Congress, First Session*. Washington, DC: Govt. Print. Off., 1967. This voluminous, 7-part committee print publishes the statements of the individuals who testified before the committee plus 246 illustrations and 25 tables containing additional data. Parts 6 and 7 consist of NASA's report on its implementation of the Apollo 204 review board's recommendations and further information relating to that implementation. Fully indexed.

United States Senate, Committee on Aeronautical and Space Sciences. *Apollo 204 Accident: Report of the Committee on Aeronautical and Space Sciences, United States Senate, with Additional Views*. Washington, DC: Govt. Print. Off., 1968. This short committee print consists of a discussion of the Apollo 204 review board, conditions leading to the accident, the accident itself, NASA's response to the review board's findings, NASA's relations with spacecraft contractors, and the effects of the accident on the Apollo schedule. In its recommendations, the report agrees with the position of NASA Administrator James Webb that not all details of government-contractor relations should be placed in the public domain, but it insists that serious problems need to be brought to the committee's attention, as was not the case before the Apollo 204 accident.

## **APOLLO 6**

United States Senate, Committee on Aeronautical and Space Sciences. *Apollo 6 Mission Hearing, Ninetieth Congress, Second Session...April 22, 1968*. Washington, DC: Govt. Print. Off., 1968. Subtitled "Summary of the Problems Encountered in the Second Flight of the Saturn V Launch Vehicle," this hearing included testimony by NASA Administrator James E. Webb and three top NASA managers involved in Apollo, George E. Mueller, Maj. Gen. Samuel C. Phillips, and George H. Hage. Includes 22 illustrations.

## **APOLLO 7**

"Apollo 7." *TRW Space Log*. 8 (Winter 1968-1969): 35-38. Provides brief descriptions of the Apollo 7 launch vehicle (Saturn IB), spacecraft (command module, service module, and spacecraft lunar module adapter), project objectives for the first human flight of Apollo spacecraft, the payload (including astronauts Walter M. Schirra, Donn F. Eisele, and Walter Cunningham), project results (all mission objectives satisfied), and major participants.

"11 Days Aboard Apollo 7." *Life*. 6 December 1968, pp. 60-74, 76, 78, 80, 82, 84. 2 B&W, 7 color photos highlight these extensive personal accounts by the Apollo 7 astronauts, Schirra, Cunningham, and Eisele.

## **APOLLO 8**

"Apollo 8." *TRW Space Log*. 8 (Winter 1968-1969): 39-42. A discussion of Apollo 8, which featured the Saturn V; a launch escape system, command module, service module, spacecraft lunar module adapter, and lunar module test article. Project results included the first circumnavigation of the Moon by humans (Frank Borman, James A. Lovell, Jr., and William A. Anders) and their safe return to Earth.

"Apollo 8: Guide to the High Adventure." *Newsweek*. 23 December 1968, pp. 50-55. Written just before the launch of Apollo 8, this brief article discusses the plans for the mission.

"Discovery." *Life*. 10 January 1969, pp. cover, 20-28. 9 color, 4 B&W photos show the launch of Apollo 8 and spectacular photos taken on the way to the Moon and back. Also, "Washington Post Front Page," p. 19. Ad by North American Rockwell depicting the newspaper's headlines on the Apollo 8 flight. Page 87 also has a photo of the orbiting astronomical observatory (OAO).

Manned Spacecraft Center. *Analysis of Apollo 8: Photography and Visual Observations*. Washington, DC: National Aeronautics and Space Administration SP-201, 1969. Consisting largely of photos, tables, contour maps, and diagrams, this volume also contains commentaries by a variety of experts from NASA Headquarters, the Goddard Space Flight Center, the Langley Research Center, the George C. Marshall Space Flight Center, the U.S. Geological Survey, the University of Arizona, Bellcomm, Inc., and other contractors. Together, they present the findings from the Apollo 8 mission in December 1968. Much of the material is highly technical, but a glossary assists the non-scientist in interpreting the analyses.

"Men and Machine." *Life*. 20 December 1968, pp. 4, 16-23. 11 color, 2 B&W photos. This pre-launch article provides a description of the Saturn V rocket and the Apollo 8 crew who would ride it—Borman, Lovell, and Anders. Includes a diary tracing the building of Saturn 5 503, the particular one they would ride.

NASA Office of Public Affairs. *Apollo 8: Man around the Moon*. Washington, DC: Govt. Print. Off., 1968. Largely photos with captions but includes short essays on topics like "The Making of an Astronaut" and "The Voyage Out."

Parker, P. J. "First Men Around the Moon." *Spaceflight*. 11 (March 1969): 91-94. A competent account of Apollo 8.

Phillips, Samuel C. "Apollo 8: A Most Fantastic Voyage." *National Geographic Magazine*. 135 (May 1969): 593-631. This lengthy account complete with numerous photographs and other illustrations, some of them quite stunning, presents a useful overview of Apollo 8 from the perspective of the director of Apollo since 1964.

Puttkamer, Jesco von. *Apollo 8, Aufbruch ins All. Der Report der ersten Mondumkreisung. Mit 29 Fotos*. München, FRG: Heyne, 1969. This little book by a NASA official explains the Apollo 8 mission day by day for readers of German.

"Satellite Support for Apollo Moonflight." *Spaceflight*. 1 (May 1969): 156-7. A discussion of the satellites that supported Apollo 8 and their roles.

## APOLLO 9

"Apollo 9." *TRW Space Log*. 9 (Summer/Fall 1969): 21-30. Like previous articles in this journal, this provides a succinct description of the mission, launch vehicle, spacecraft, and results, which included the first test of the lunar module. In Earth orbit, the module separated from the command and service modules and then returned and docked with them.

"Apollo 9 Album." *Life*. 28 March 1969, pp. 26-37. 12 color photos show highlights of the Apollo 9 Earth-orbital mission. Good photos of the lunar excursion module.

*Code Name Spider: Flight of Apollo 9*. Washington, DC: NASA EP-68, 1969. This oddly-titled pamphlet, referring to the code name for the lunar module used on Apollo 9, describes that spacecraft, preparations for the mission, the mission itself, and the return to Earth—all accompanied by numerous photographs.

Parker, P. J. "Apollo 9 Tests Lunar Module." *Spaceflight*. 11 (July 1969): 230-233. This brief discussion, purportedly of the first operational test of the lunar module, really is a more or less blow-by-blow description of the entire Apollo 9 mission from pre-launch through the lunar module test itself to the return to Earth after 10 days in space.

## APOLLO 10

Air Force Aeronautical Chart and Information Center. *Apollo Mission 10 Photography Indexes Prepared Under the Direction of the Department of Defense by the Aeronautical Chart and Information Center, United States Air Force for the National Aeronautics and Space Administration*. Saint Louis: AF Aeronautical Chart and Information Center, 1969. A series of fold-out maps of the Moon showing locations where individual photographs were exposed.

"Apollo 10." *TRW Space Log*. 9 (Summer/Fall 1969): 30-34. Discusses the similarities with and differences from Apollo 9, the principal difference being that the mission took place in lunar rather than Earth orbit.

"Apollo 10: Next Step the Moon." *Interavia*. 24 (July 1969): 879-82. A detailed and comprehensible account of the Apollo 10 mission from launch to splashdown, accompanied by photos.

Manned Spacecraft Center. *Analysis of Apollo 10: Photography and Visual Observations*. Washington, DC: NASA SP-232, 1971. The bulk of this volume consists of individual photographs, tables, graphs, and contour maps depicting the results of photography done during the Apollo 10 mission in May 1969. Interspersed among these are analyses and interpretations by experts from the Manned Spacecraft Center, the U.S. Geological Survey, the Smithsonian Astrophysical Observatory, the University of Arizona, and Bellcomm, Inc. A glossary helps the lay reader understand the often highly technical material, but some of it will be intelligible only to those initiated in the fields of lunar science.

"Man's Vision of the Lunar Voyage—Suddenly Real." *Life*. 30 May 1969, pp. 3, 48-52A. 4 color, 7 B&W photos. Covers the launch and flight to the Moon of Apollo 10 including pictures of the Earth and Moon taken from TV monitors.

National Aeronautics and Space Administration. *Mission Report: Apollo 10*. Washington, DC: NASA EP-70, 1969. In this 12-page booklet NASA recounts the 8-day mission of Apollo 10 to test the lunar module, code-named Snoopy, in its circuits around the Moon and descent to within 8.4 nautical miles of the Earth's satellite to inspect the preferred landing site for Apollo 11.

Parker, P. J. "Apollo 10—The Last Rehearsal." *Spaceflight*. 11 (August 1969): 275—78, 290. Covers the Apollo 10 mission from pre-launch activities through its successful return to Earth following orbit of the Moon and complex maneuvers with the lunar module named "Snoopy." Detailed and somewhat technical, this is nevertheless accessible to the non-expert.

## APOLLO 11

Air Force Aeronautical Chart and Information Center. *Apollo Mission 11 Photography Indexes*. St. Louis: AF Aeronautical Chart and Information Center, 1969. A series of fold-out maps of the Moon showing locations where individual photographs were exposed.

Anderson, Arthur T.; Michlovitz, C.K.; and Hug, K. *Apollo 11 Lunar Photography: Data Users' Note*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1970. A guide for aiding investigators in selecting Apollo 11 photos for study and in interpreting the photographs.

"Apollo 11." *TRW Space Log*. 9 (Winter 1969-1970): 11-22. Provides a description of humankind's first landing on the Moon that is similar to the previous TRW discussions of earlier missions, noting that an estimated 530 million people around the world watched as Neil Armstrong descended from the lunar module to the surface of the Moon.

*Apollo 11: On the Moon*. A Look Special with text by *The New York Times* and photographs by the Apollo Astronauts. 1969. Besides numerous photographs, this edition includes articles on the Apollo 11 astronauts, the mission (by *Times* science writer John Noble Wilford), the decision to go to the Moon (by then-assistant professor at Catholic University, John M. Logsdon), and the future (by science fiction writer Arthur C. Clarke).

"Apollo's Great Leap for the Moon." *Life*. 25 July 1969, pp. cover, 18D-29. 9 color, 7 B&W photos detail the events surrounding the liftoff of Apollo 11 to the Moon. Spectacular photos of the crowds and panorama of the launch. Also, "Ten Years that led to Apollo 11," p. 3; 32 *Life* covers over the years are shown as documenting steps in the space program.

*Apollo 11's Moon Landing*. Fresno, CA: California Microfilm Co., 1969. This is a collection of newspaper and magazine clippings on Apollo 11.

"Apollo 11 Tracking Force Readied." *Aviation Week and Space Technology*. 14 July 1969, pp. 91, 93-94, 99, 103. Describes the 4,500-person tracking force in NASA's Manned Space Flight Network then preparing to monitor the Apollo 11 mission. The network included 11 Earth orbital stations and 4 tracking ships with 30-foot-diameter parabolic antennas, plus 3 stations with 85-foot-diameter dishes. Includes 5 photos and a map.

Armstrong, Neil; Aldrin, Edwin; and Collins, Michael. *The First Lunar Landing: 20th Anniversary/as Told by the Astronauts, Neil Armstrong, Edwin Aldrin, Michael Collins*. Washington, DC: NASA EP-73, 1989. This is a short, 24 page, recollection of the Apollo 11 mission by the astronauts; it was published under the auspices of the NASA Office of Public Affairs.

Barbour, John. *Footprints on the Moon*. Washington, DC: The Associated Press, 1969. This illustrated history consists of 12 chapters with numerous photographs to produce a popular history that capitalized on the interest surrounding the flight of Apollo 11 in 1969.

Büdeler, W. "The Apollo 11 Moon Landing." *Interavia*. 24 (September 1969): 1497-1503. This account by a German expert on space history recounts the history of the entire Apollo program in brief compass; discusses launch vehicle development; describes the command, service, and lunar modules; succinctly covers Apollos 7-10; and then provides a fairly detailed description of Apollo 11, complete with photos. The article includes tables for the 5 Apollo flights to date, the Apollo 11 timetable of events, and the major contractors in the program. Although it does not avoid the usual Apollo acronyms, it does spell them out on first use and is generally not only informative but comprehensible to the lay reader. This issue of *Interavia* follows this article with shorter pieces on "NASA's Manned Spacecraft Center," "The Apollo programme in pictures," and "The Apollo astronauts' space suits," all without attribution as to their authors.

CBS News. 10:56:20 PM EDT, 7/20/69: *The Historic Conquest of the Moon as Reported to the American People*. New York: Columbia Broadcasting System, 1970. As the title suggests, this is an attempt to capture in print and pictures the reporting on humankind's first landing on the Moon during Apollo 11. More useful in capturing the immediacy of the moment than in providing an historical assessment of the event and its significance.

- Department of Defense Support: Apollo 11.* Patrick AFB, FL: Department of Defense Manned Space Flight Office, n.d. This booklet, a copy of which is available in the NASA History Office's Reference Collection, contains a useful discussion of Defense support for Apollo with sections on DoD tracking stations, aircraft, and ships; medical support; recovery forces; communications; and weather. In the back of the booklet are helpful maps and biographies of military personnel critical to Apollo support.
- "Down to the Moon... and the Giant Step." *Life*. 8 August 1969, pp. cover, 18-29. 22 color photos. spectacular photos of the landing of Apollo 11 on the Moon, shots on the surface, and the astronauts back home.
- Flight Operations Reunion for the 20[th] Anniversary of the First Manned Lunar Landing: 1969-1989.* Washington, DC: National Aeronautics and Space Administration, 1989. This curious reunion booklet consists of a variety of items mostly of interest only to those who participated in the reunion but including an Apollo 11 mission summary and related photos. A large portion of the paperback volume, however, consists of photos of the participants and brief statements by them about the roles they played in Apollo 11 and their activities at the time of the reunion.
- Footprints on the Moon.* Clinton, IA: Eduvision Co., 1969. Another illustrated history, this one consists of a cobbling together of Associated Press stories with numerous photographs to produce a history that capitalizes on the interest surrounding the flight of Apollo 11 in 1969.
- Manned Spacecraft Center. *Apollo 11 Mission Report.* Washington, DC: NASA SP-238, 1971. This detailed account of the mission includes a summary, introduction, mission description, pilots' report, and accounts of lunar descent and ascent; communications; trajectory; performance of the command and service modules, lunar module, and extravehicular mobility unit; the lunar surface; the biomedical evaluation; and sundry other matters including mission support performance. Appendices on Apollo spacecraft flight history, vehicle descriptions, and a glossary round out the package.
- Manned Spacecraft Center. *Apollo 11 Photography, 70-mm, 16-mm, and 35-mm Frame Index.* Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. A list of tables containing supporting information about each photograph taken during the Apollo 11 mission. For use with other Apollo 11 indexes and the photographs themselves.
- Moreau, John E. Compiler. *First Men on the Moon: Historic Front Pages.* Dayton, OH, 1972. As the title suggests, copies of front pages from 139 different newspapers announcing the Apollo 11 landing on the Moon. Sources range from *The Pueblo Chieftan* (CO) to the *Rutland Herald* (VT) and *The Missoulian* (MT), in addition to papers from more major metropolitan areas.
- National Space Science Data Center. *Apollo 11 70-mm Photographic Catalog.* Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. A compilation of proof prints for virtually all the 70-mm photography exposed during the Apollo 11 mission, sorted by magazine and frame number. Designed for use in conjunction with other indexes.
- National Space Science Data Center. *Apollo 11 Photographic Data Package.* Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. Another reference volume on Apollo photography, similar to others with like titles (see below under Apollo 12).
- North American Rockwell Corporation Space Division. *Man on the Moon.* Washington, DC: United States Information Agency, 1969. One of the prime Apollo contractors provides a large-format, coffee-table book covering the Apollo 11 mission, the men, the machines, and the team that carried it off. Lavishly illustrated, this volume also has some informative narrative that provides an overview of the program and the mission.

"Off to the Moon." *Life*. 4 July 1969, entire issue. This issue with many illustrations covers Apollo 11 from many perspectives. Among other things, it includes biographies of astronauts Aldrin, Armstrong, and Collins, a poem by James Dickey, and reflections by Charles Lindbergh about the relationship of his own pioneering flight across the Atlantic to that of the initial trip to the Moon.

Parker, P. J. "Man on the Moon-I." *Spaceflight*. 11 (September 1969): 313-17. This initial segment of a two-part article gives a lengthy account of the Apollo 11 mission from pre-launch through a portion of the lunar surface activity.

\_\_\_\_\_. "Man on the Moon-II." *Spaceflight*. 11 (October 1969): 338-41. Concludes the account of Apollo 11, carrying the story from the conclusion of the lunar surface activities to splashdown with a brief description of the preliminary scientific results from the mission.

Shayler, David J. *From the Flightdeck 4: Apollo 11 Moon Landing*. London: Ian Allen Ltd, 1989. This 80-page, 20th anniversary paperback for a popular audience includes numerous drawings and photographs plus narrative coverage of the Apollo 11 mission.

Sparks, James C. *Moon Landing, Project Apollo*. New York: Dodd, Mead, 1970. Another popular history, this book traces each step of the Apollo 11 flight, from the development of the "hardware" to splashdown, and analyzes the importance of this mission and future space exploration.

"Special Report: Apollo 11 Lunar Landing." *Aviation Week & Space Technology*. 91 (28 July 1969): 22-40. A series of articles and a photo essay discussing such issues as the information yielded by the mission, the way the spacesuits worked, the lunar landing, and the items left on the Moon.

Sprung, Jeffrey V. *Apollo 11: Man's Greatest Adventure*. New York: American Broadcasting Companies, 1969. This illustrated 53-page book, with a phonodisc (10 in., 33 1/3 rpm. microgroove) containing a medley of comments by various people from Presidents Eisenhower and Kennedy to the astronauts, presents the story of Apollo 11 and its antecedents in picture, text, and sound, including a the sounds of the Saturn V launching the three astronauts to the Moon.

"To the Moon and Back." *Life*. Special Edition. 1969. 86 pages. Complete coverage of the Apollo 11 flight from preflight training to splashdown. Many large color photos taken on the mission. Pictorial biographies of the astronauts. Expanded versions of some previous *Life* articles. A real collector's item.

Weaver, Kenneth F. "The Flight of Apollo 11: 'One Giant Leap for Mankind'." *National Geographic Magazine*. 136 (December 1969): 752-87. Part of a five-part series of articles entitled "First Explorers on the Moon," this long article by Assistant Editor Weaver follows text and photographs by the Apollo 11 astronauts and Frank Borman in relating the events of the first human landing on the Moon. Complete with the photography for which the magazine is deservedly famous, this well-written account offers a useful, nearly contemporary overview.

\_\_\_\_\_. "A Trip to the Moon." *Air and Space/Smithsonian*. 4 (June/July 1989): 62-73. This article discusses the history of the Apollo 11 mission, including the policy decisions and technological development leading up to the lunar landing, the preliminary Ranger missions to study the surface of the Moon, the configuration of the mission, and the events from launch of the Saturn V booster through the landing of the Eagle on the Moon and the subsequent rendezvous with the Columbia lunar orbiting vehicle to the flight back to planet Earth.

Wilford, John Noble. *We Reach the Moon: The New York Times Story of Man's Greatest Adventure*. New York: Bantam Books, 1969. One of the earliest of the journalistic accounts to appear at the time of Apollo 11, a

key feature of this general and journeymanlike but not distinguished history is a 64 page color insert with photographs of the mission. It was prepared by the science writer of the *New York Times* using his past articles.

Wilhelms, Don. "A Smooth Spot in Tranquility." *Air and Space/Smithsonian*. 4 (June/July 1989): 42-47. Discusses the process for selecting the landing site for Apollo 11; the geological, scientific, and engineering considerations critical for site selection; and the collaboration between NASA and the U.S. Geological Survey that preceded the choice of the location for the landing.

Young, Kenneth A., and Alexander, James D. "Apollo Lunar Rendezvous." *Journal of Spacecraft and Rockets*. 7 (September 1970): 1083-86. This piece by two NASA officials at the Manned Spacecraft Center provides a technical description of the lunar rendezvous carried out on Apollo 11.

## APOLLO 12

Air Force Aeronautical Chart and Information Center. *Apollo Mission 12 Lunar Photography Indexes*. Saint Louis: AF Aeronautical Chart and Information Center, 1970. A series of fold-out maps of the Moon showing locations where individual photographs were exposed.

Anderson, Arthur T.; Michlovitz, C.K.; and Hug, K. *Apollo 12 Lunar Photography: Data Users' Note*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1970. A guide for aiding investigators in selecting Apollo 12 photos for study and in interpreting the photographs.

"Apollo 12." *TRW Space Log*. 9 (Winter 1969-1970): 22-30. Discusses the second lunar landing in similar fashion to previous TRW accounts of Apollo missions.

"How Apollo 12 was Planned." *Space World*. February 1970, pp. 4-47. Somewhat mistitled, this lengthy article describes, not the planning process for Apollo 12 but rather the flight plan—not how managers planned the mission but the product of their planning efforts.

NASA Office of Public Affairs. *Apollo 12: A New Vista for Lunar Science*. Washington, DC: NASA EP-74, 1970. Follows the astronauts in text and photos as they collected lunar samples.

National Space Science Data Center. *Apollo 12 70-mm Photographic Catalog*. Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. A compilation of proof prints for virtually all the 70-mm photography exposed during the Apollo 12 mission, sorted by magazine and frame number. Designed for use in conjunction with other indexes.

National Space Science Data Center. *Apollo 12 Photographic Data Package*. Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. This catalog consists of proof prints of the 70-mm photography done during Apollo 12. It is designed to be used in conjunction with the Apollo 12 frame index to permit location of the area covered by each frame.

Parker, P. J. "The Triumph of Apollo 12." *Spaceflight*. 12 (February 1970): 77-81. Still another of Parker's competent accounts of Apollo missions, this one covers the first half of the second voyage to the Moon.

\_\_\_\_\_. "The Triumph of Apollo 12 (Concluded)." *Spaceflight*. 12 (March 1970): 118-20. This conclusion of the preceding article covers the last portion of the account of lunar science on Apollo 12 and the return to Earth, with a table of Apollo 12 timelines added for good measure.

## APOLLO 13

- "Apollo 13." *TRW Space Log*. 10 (1970-1971): 5-9. In somewhat analogous fashion to previous TRW accounts, this one details the near-tragic mission on which a short circuit ignited electrical insulation in spacecraft oxygen tank number 2 of the service module, causing the mission to be aborted and the crew to use the lunar module for life support through most of the return to Earth.
- Cooper, Henry S. F., Jr. *Thirteen: The Flight that Failed*. New York: Dial Press, 1973. In this highly personalized and readable account, Cooper retells the battle for survival of the Apollo 13 astronauts after the disabling of the service module as a result of the bursting of one of its oxygen tanks from an electrical malfunction.
- "Four Days of Peril Between Earth and Moon: Apollo 13, Ill-Fated Odyssey." *Time*. 27 April 1970, pp. 14-18. Describes how, when the command and service module (CSM) carrying the astronauts around the Moon became crippled as a result of a series of short circuits, the Apollo 13 astronauts boarded the lunar (LM) module for the life support needed until they could propel the combined CSM-LM into a return trajectory to Earth. After jettisoning the service module, which was badly damaged, the crew reentered the command module about an hour before reentry and abandoned the LM lifeboat. Through the teamwork of the crew and mission control the mission could not be salvaged but the astronauts were able to return safely to Earth.
- "The Joyous Triumph of Apollo 13." *Life*. 24 April 1970, pp. cover, 28-36. 11 color, 6 B&W photos highlight this early coverage of the near-disaster in space onboard Apollo 13. Includes a profile of the crew and the anguished families at home.
- NASA Office of Public Affairs. *Apollo 13: "Houston, We've Got a Problem."* Washington, DC: NASA EP-76, 1970. This 25-page brochure explores the electrical problems in the service module on Apollo 13 and the resultant necessity to abandon the mission and devote all attention to returning the three astronauts to Earth safely. The brochure explains how this was done by using the lunar module, Aquarius, as a lifeboat and a source of power to propel the lunar and command modules into a trajectory that would return the latter to the home planet after the astronauts reentered it for the splashdown, jettisoning the damaged service module and then the lunar module. The procedure worked, and President Nixon later stated, "The three astronauts did not reach the Moon, but they reached the hearts of millions of people in America and in the world."
- National Space Science Data Center. *Apollo 13 Photographic Data Package*. Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1970. A photographic reference volume similar to the one for Apollo 12 described above.
- "13 Was a Good Target for the Law of Averages." *Life*. 1 May 1970, pp. 24-33. 10 color photos. The personal accounts of the Apollo 13 astronauts and their struggle to survive on their crippled craft.
- United States Senate, Committee on Aeronautical and Space Sciences. *Apollo 13 Mission. Hearing, Ninety-first Congress, Second Session. April 24, 1970*. Washington, DC: Govt. Print. Off., 1970. Contains statements by NASA Administrator Thomas O. Paine, Apollo Program Director Rocco A. Petrone, Apollo 13 Mission Director Glynn S. Lunney, and the three Apollo 13 astronauts, followed by questions from the committee members and the responses of the NASA personnel. Includes 11 illustrations and 2 documents regarding the establishment of the Apollo 13 Review Board.
- United States Senate, Committee on Aeronautical and Space Sciences. *Apollo 13 Mission Review. Hearing, Ninety-first Congress, Second Session. June 30, 1970*. Washington, DC: Govt. Print. Off., 1970. Contains the review boards findings with 31 illustrations plus testimony by NASA Administrator Thomas O. Paine,

Review Board Chair Edgar M. Cortright, Associate Administrator for Manned Space Flight Dale D. Myers, and Apollo Program Director Rocco A. Petrone, followed by their questions from and answers to committee members.

## APOLLO 14

"Apollo 14." *TRW Space Log*. 10 (1970-1971): 10-13. Discusses the third successful trip to the Moon, this time to the Fra Mauro crater about 100 miles east of the landing site for Apollo 12.

"Apollo 14." *Interavia*. 26 (April 1971): 383-85. A discussion of "the most science-oriented moon expedition so far," this large-formatted article provides diagrams and photos as well as prose descriptions of the experiments and investigations carried out on the Moon and in orbit around it.

Baker, David. "Apollo 14: A Visit to Fra Mauro." *Spaceflight*. 13 (May 1971): 164-69. This initial installment on Apollo 14 discusses the mission, including the hardware changes since Apollo 13, flight preparations, flight operations, and operations on the Moon's surface. Technical in places, the writing is generally accessible to the lay reader.

\_\_\_\_\_. "Apollo 14: A Visit to Fra Mauro-2." *Spaceflight*. 13 (June 1971): 210-12. This continuation of the preceding article continues its treatment of surface operations and covers the astronauts' return to Earth.

\_\_\_\_\_. "Apollo 14: A Visit to Fra Mauro-3." *Spaceflight*. 13 (October 1971): 373-76. A postscript to the previous articles, this is a lengthy series of tables showing the sequence of events during the mission.

Froehlich, Walter. *Apollo 14: Science at Fra Mauro*. Washington, DC: NASA EP-91, 1971. This account of the lunar portion of Apollo 14 is as much about the astronauts and their equipment as it is about science, but it provides a good description of what went on on the Moon and of the splashdown when the astronauts returned to Earth.

Hall, Alice J. "The Climb up Cone Crater." *National Geographic Magazine*. 140 (July 1971): 136-48. A discussion of "man's longest lunar walk to date" on Apollo 14, this thoroughly illustrated article follows astronauts Alan B. Shepard, Jr., and Edgar D. Mitchell on their trek, quoting them liberally.

National Space Science Data Center. *Apollo 14 Photographic Data Package*. Greenbelt, MD: National Space Data Center, Goddard Space Flight Center, 1971. A similar reference work on lunar photography to the one described above on Apollo 12.

"White Tracks on the Moon." *Life*. 26 February 1971, pp. 2A, 26-29. 2 color, 3 B&W photos taken on the Moon by the Apollo 14 astronauts.

## APOLLO 15

Air Force Aeronautical Chart and Information Center. *Apollo Mission 15 Lunar Photography Index Maps*. St. Louis: AF Aeronautical Chart and Information Center, 1972. A series of fold-out maps of the Moon showing locations where individual photographs were exposed.

"Apollo 15, P&F Subsatellite." *TRW Space Log*. 10 (1970-1971): 14-18. Discusses the differences in scientific instrumentation and exploration equipment aboard Apollo 15, including the first lunar roving vehicle.

Baker, David. "Expedition to Hadley-Apennine-1." *Spaceflight*. 13 (October 1971): 358-62, 383. This beginning account of Apollo 15 follows the general pattern of the previous sequence of articles, providing coverage of hardware and equipment changes since Apollo 14, a flight profile, site description, and

discussion of the mission. Replete with more jargon and acronyms than absolutely necessary, these articles are nonetheless generally readable.

\_\_\_\_\_. "Expedition to Hadley-Apennine-2." *Spaceflight*. 13 (November 1971): 431-35. This continuation of the previous article discusses the prelude to exploration, the three days spent on the Moon, and excursions in the lunar roving vehicle.

\_\_\_\_\_. "Expedition to Hadley-Apennine-3." *Spaceflight*. 13 (December 1971): 468-70. This conclusion to the sequence of articles on Apollo 15 discusses the ascent to lunar orbit from the surface of the Moon, experiments in orbit, and the return to Earth.

Cameron, Winifred Sawtell and Mikesch, Mary Anne. *Apollo 15 Lunar Photography; Data Users' Note*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1972. A photographic reference volume similar to similarly-titled ones for earlier missions.

"From the Good Earth to the Sea of Rains." *Time*. 9 August 1971, pp. 10-15. A personalized account of the Apollo 15 trip to the Moon as seen through the eyes of astronauts and scientists.

Lockheed Electronics Company, Inc. *Apollo 15 Index of 70 mm Photographs*. Houston, TX: Manned Spacecraft Center, 1972. A description and cross-indexing of Apollo 15 70 mm photographs.

NASA Office of Public Affairs. *Apollo 15 at Hadley Base*. Washington, DC: NASA EP-94, 1971. A brief description of the mission with lots of captioned photographs.

Simmons, Gene. *On the Moon with Apollo 15: A Guidebook to Hadley Rille and the Apennine Mountains*. Washington: National Aeronautics and Space Administration, 1971. This guidebook by the chief scientist at the Manned Spacecraft Center was intended to provide background for interested television viewers of scientific activities on Apollo 15. Necessarily written before the mission, the publication contains an introduction providing background to the mission and explaining how it would unfold. It follows this with a description of the landing site and the lunar roving vehicle, then a discussion of the scientific activities the astronauts would carry out on the Moon. A segment on the crew, bibliography, glossary of terms, list of acronyms, and some tables on various aspects of the mission complete the package, which still provides a useful introduction to the mission.

United States House, Committee on Science and Astronautics. *Apollo 15 Mission Report*. Hearings, Ninety-second Congress, first session. September 9, 1971. Washington, DC: Govt. Print. Off., 1971. Consists of statements by and questioning of the three Apollo 15 astronauts, David R. Scott, James B. Irwin, and Alfred M. Worden. Contains 24 illustrations.

Weaver, Kenneth F. "To the Mountains of the Moon." *National Geographic Magazine*. 141 (February 1972): 230-65. This lengthy account by an assistant editor of the magazine provides competent and readable coverage of the Apollo 15 mission, complete with large numbers of photographs.

## **APOLLO 16**

"Apollo 16 Explores Lunar Highlands." *Aviation Week and Space Technology*. 15 May 1972, pp. 41-49. 14 color photos depict the lunar highlands as viewed by the Apollo 16 astronauts.

Baker, David. "Mission to Descartes-1." *Spaceflight*. 14 (July 1972): 246-51. This initial account of Apollo 16 follows the general pattern of the previous accounts, carrying the mission through in-flight problems that proved serious but did not cause the mission to be aborted.

- \_\_\_\_\_. "Mission to Descartes-2." *Spaceflight*. 14 (August 1972): 287-91. Continues the preceding account, covering the mission from lunar landing to the safe return to Earth.
- Batson, R.M., et al. *Preliminary Catalog of Pictures Taken on the Lunar Surface during the Apollo 16 Mission*. Washington, DC: U.S. Geological Survey, 1972. Still another photographic catalog.
- Cameron, Winifred Sawtell, et al., *Apollo 16 Lunar Photography*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1973. A further volume of lunar photographs, this time from Apollo 16
- Cameron, Winifred Sawtell, et al., *Apollo 16 Lunar Photography; Data Users' Note*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1973. A further reference work on lunar photography to accompany the preceding volume.
- Lockheed Electronics Company, Inc. *Apollo 16 Index of 70mm Photographs and 16mm Film Strips*. Houston, TX: Manned Spacecraft Center, 1972. A description and cross-indexing of Apollo 16 70mm photographs and 16mm film strips.
- NASA Office of Public Affairs. *Apollo 16 at Descartes*. Washington, DC: NASA EP-97, 1972. A discussion of the overall mission with copious photos.
- United States House, Committee on Science and Aeronautics. *Apollo 16 Mission Report. Hearing, Ninety-second Congress, Second Session, May 16, 1972*. Washington, DC: Government Printing Office, 1972. Testimony by and questioning of the three Apollo 16 astronauts, John Young, Charles Duke, and Ken Mattingly. Includes 16 illustrations.

## APOLLO 17

- Anderton, David A. *Apollo 17 at Taurus Littrow*. Washington, DC: NASA EP-102, 1973. A reasonably detailed description of the overall mission together with numerous captioned photographs.
- Apollo 17, the Most Productive Lunar Expedition*. Washington, DC: NASA Mission Report MR-12, 1977. This 8-page pamphlet summarizes the mission in photos and narrative.
- Baker, David. "The Last Apollo-1." *Spaceflight*. 15 (February 1973): 42-47. Following the precedent of the previous series of articles, this one begins coverage of Apollo 17, carrying the story through the boost into trans-lunar trajectory.
- \_\_\_\_\_. "The Last Apollo-2." *Spaceflight*. 15 (March 1973): 87-91. This follow-on article carries the mission from trans-lunar injection through the third excursion in the lunar roving vehicle.
- \_\_\_\_\_. "The Last Apollo-3." *Spaceflight*. 15 (April 1973): 145-48. The concluding article in the series covers the Apollo 17 astronauts' return to lunar orbit and the trip home to Earth.
- Cameron, Winifred Sawtell, et al., *Apollo 17 Lunar Photography*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1974. Still another book of lunar photographs, similar to volumes for previous missions.
- Cameron, Winifred Sawtell, et al., *Apollo 17 Lunar Photography; Data Users' Note*. Greenbelt, MD: National Space Science Data Center, Goddard Space Flight Center, 1974. Companion reference notes to the preceding volume.

Defense Mapping Agency Aerospace Center. *Apollo 17 Index: Mapping Camera and Panoramic Camera Photographs*. Houston, TX: Johnson Space Center, 1973. An index of supplemental data for all photographs taken from the scientific instrument module on the service module of the Apollo 17 spacecraft.

Larson, K.B., et al. *Preliminary Catalog of Pictures Taken on the Lunar Surface during the Apollo 17 Mission*. Washington, DC: U.S. Geological Survey, 1973. A catalog for the volume of Apollo 17 lunar photographs.

## APOLLO-SOYUZ

El-Baz, Farouk. Editor. *Catalog of Earth Photographs from the Apollo-Soyuz Test Project*. Washington, DC: Lyndon B. Johnson Space Center, 1979. A guide to usable photographs of the Earth obtained by the Apollo-Soyuz astronauts.

Eyermann, Karl-Heinz. *Sojus, Apollo 1975*. Leipzig, FRG: Urania-Verlag, 1975. A popular account of Apollo-Soyuz for the general German reader with a section on technology and a number of photos and diagrams.

Ezell, Edward Clinton, and Ezell, Linda Neuman. *The Partnership: A History of the Apollo-Soyuz Test Project*. Washington, DC: NASA SP-4209, 1978. This solid and detailed history of the joint space venture of the United States and the Soviet Union in 1975 is based on numerous official sources, oral interviews, and tape recordings by the authors of meetings and conversations with participants in the preparations for the mission. Thus, in many ways this is a first-hand account distilling not only the contents of technical documents but also the contemporary comments and experiences of participants. The book begins with the background to the mission, going back to the Cold War competition between the United States and the Soviet Union. It recounts the early proposals for cooperation between the two world powers, especially those in the early and mid-1960s that reached a temporary dead end. The authors follow this with an account of the discussions in the early 1970s that led to the actual joint mission. More than a diplomatic history, however, the volume describes the design, development, and production of "the hardware and systems whereby two spacecraft from different traditions could be joined together in space" (p. 354 of the book). The authors also relate how NASA deputy administrator George Low had foreseen that space exploration was too expensive for both powers to continue duplicative programs forever. At the time the book was written, this was still speculation, but now it is clear that this book provides an important prologue to the current plans for cooperation in space by the United States and Russia.

Froehlich, Walter. *Apollo-Soyuz*. Washington, DC: NASA EP-109, 1976. This handsome little pictorial history contains a rather extensive text discussing the background to the mission, the spacecraft, the scientific experiments, the men involved, the reentry, and the significance of the American-Soviet cooperation in space. A number of tables complement the text. Written by a journalist, the volume is highly readable though far from definitive.

Lebedev, L.A. [Lev Aleksandrovich] and Romanov, Alexander. *Rendezvous in Space: Soyuz Apollo*. Moscow: Progress Publishers, 1979. Translated from the Russian by Leonard Stoklitsky. This volume provides Soviet perspective on the joint mission.

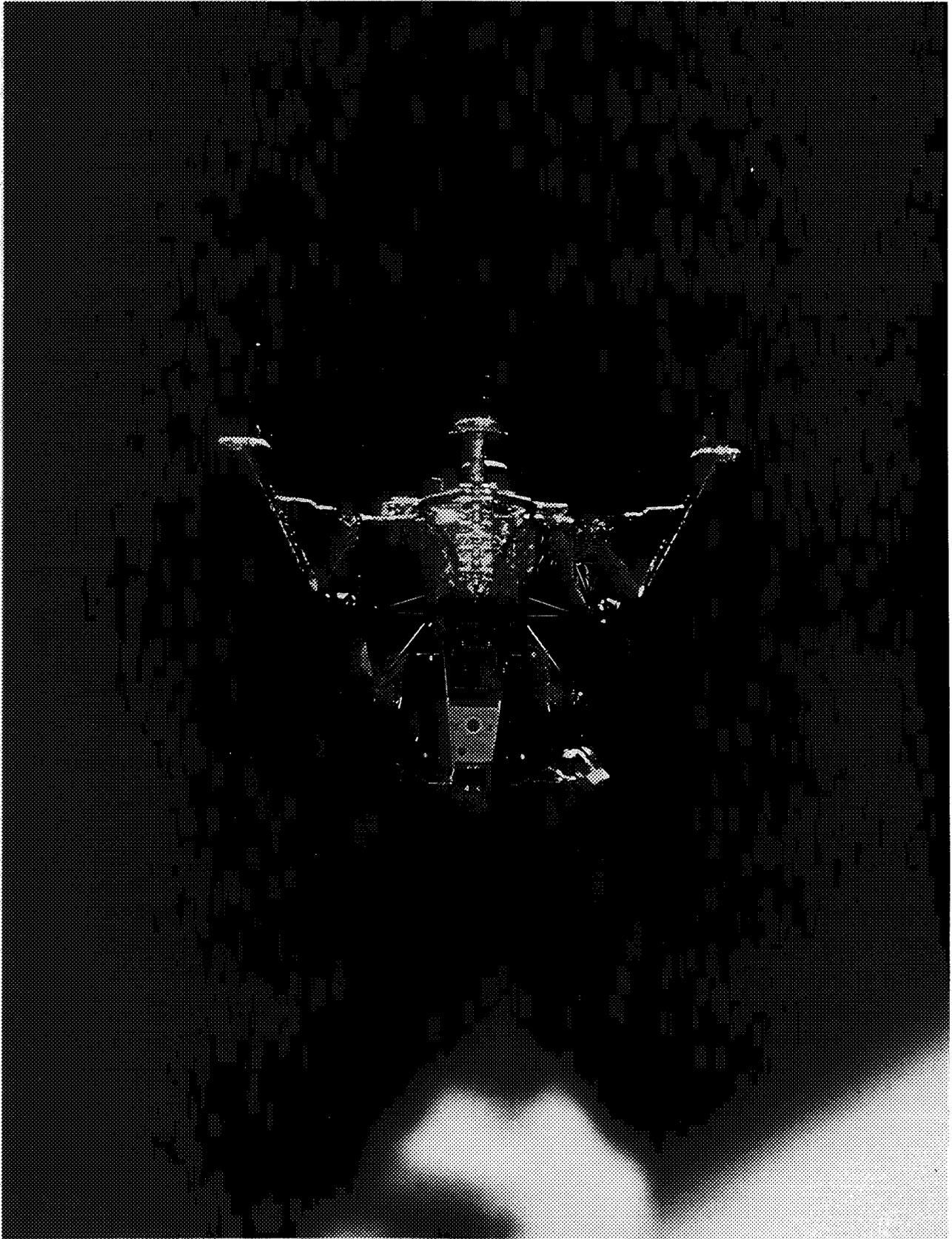
Lee, Chester M., ed. *Apollo Soyuz Mission Report*. San Diego, CA: Univelt, 1976. This detailed account of the Apollo Soyuz mission provides a handy mission summary in its beginning pages and then analyzes the spacecraft systems performance, the crew station, the experiments performed, inflight demonstrations, joint flight activities, biomedical matters, and anomalies experienced during the mission. Although written in the passive voice, making it both less readable and less informative about some matters than it might have been, the report contains a great deal of information, much of it comprehensible to the lay reader. A number of appendices supplement the information in the text.

National Aeronautics and Space Administration. *Apollo Soyuz Test Project: First International Manned Space Flight, July 15-24, 1975*. Washington, DC: National Aeronautics and Space Administration, 1975. This 17-page pamphlet contains a brief rundown on the objectives of the mission, the mission itself and recovery of the crew, a listing of experiments performed, followed by much more extensive crew biographies for both the American and Soviet crew members.

Page, Lou Williams and Page, Thornton. *Apollo-Soyuz*. Washington, DC: NASA EPs-133 through 141, 1977. These nine pamphlets are based on investigators' reports of experimental results, written with the help of advising teachers to serve as "curriculum supplements designed for teachers, supervisors, curriculum specialists, and textbook writers as well as for the general public." Dr. Lou Williams Page, a geologist, and Dr. Thornton Page, an astronomer, brought their special expertise to the writing. They divided the topics of individual pamphlets into "The Flight," "X-Rays, Gamma-Rays," "Sun, Stars, In Between," "Gravitational Field," "The Earth from Orbit," "Cosmic Ray Dosage," "Biology in Zero-G," "Zero-G Technology," and "General Science."

*The Soyuz-Apollo Project*. Moscow, USSR: Novosti Press Agency Pub. House, 1975. A pre-mission account from the Soviet perspective on the upcoming Apollo-Soyuz mission, as Americans call it. It includes biographies of the crew members and a discussion of joint flight preparations through December 1974.

United States House, Committee on Science and Astronautics. *Space Shuttle, Space Tug, Apollo-Soyuz Test Project—1974; Status Report*. Ninety-third Congress, Second Session. February 1974. Washington, DC: Govt. Print. Off., 1974. This lengthy report consists of a summary, conclusions, and a series of briefings by representatives of various NASA centers and contractors. One of the conclusions was that the "Apollo-Soyuz Test Project is proceeding on schedule and within the costs projected."



*The lunar module with Astronauts Neil Armstrong and Edwin Aldrin inside after it separated from the command module on Apollo 11. NASA photo 69-H-1376.*

# CHAPTER 6

## POPULAR CULTURE AND PROMOTION

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Atwill, William Dorsey. "Fire and Power: Narratives of the Space Age." Ph.D. Diss. Duke University, 1990. A deconstructive analysis of the space program using Apollo images and rhetoric.

Bainbridge, William Sims. "The Impact of Science Fiction on Attitudes Toward Technology." In Emme, Eugene M. Editor. *Science Fiction and Space Futures, Past and Present*. San Diego, CA: AAS History Series, Vol. 5, American Astronautical Society, 1982. Pp. 121-35. In this article the author challenges the traditional interpretation that science fiction informs the reader about science and propagandizes in favor of technological progress. Instead, he finds that new schools of science fiction sometimes promulgate entirely different sets of values based on an anti-technology bias. Even so, Bainbridge documents the close linkage between science fiction as a promoter of spaceflight and other technological advances. Such a linkage was present in the Apollo program of the 1960s.

\_\_\_\_\_. *The Spaceflight Revolution: A Sociological Study*. New York: Wiley-Interscience, 1976. Reprint, Malabar, FL: Robert E. Krieger Publishing Company, 1983. This important but not entirely persuasive sociological study traces the development of the idea of spaceflight from its science-fictional beginnings through the rise of mass market magazines and compares it with the actual fact of spaceflight as it emerged in the 1960s. The author finds that a conspiracy of technological zealots manipulated the U.S. government to create an organization and fund an aggressive lunar landing program. Bainbridge asserts that "Not the public will, but private fanaticism drove men to the moon" (p. 1). The book's strength rests on Bainbridge's analysis of the American and British Interplanetary Societies, the science fiction subculture, the "Committee of the Future" (1970-1974) of the World Future Society, and the role of "fandom" in promoting spaceflight. This type of analysis, while useful, is not carefully tied to the development of public policy relating to the space program. In spite of the argument's other attractions, Bainbridge does not convincingly demonstrate how the "space boosters" were able to create Project Apollo and to persuade President Kennedy to announce his lunar decision in 1961.

Bergerac, Cyrano de. *Voyage dans la Lune (The Voyage to the Moon)*. Paris, 1649. This book describes a fictional trip to the Moon by propulsion from firecrackers. As soldiers lit fuses to the firecrackers, the hero jumped into a gondola and tier upon tier of explosives ignited like rockets and launched him to the Moon. Thus Cyrano's hero became the first flyer in fiction to reach the Moon by means of rocket thrust, a premonition of Newton's third law of gravity about every action having an equal and opposite reaction. Once on the Moon, the character in this novel had several adventures, and later in the book he also journeyed to the Sun.

Braun, Wernher von. "Crossing the Last Frontier." *Collier's*. 22 March 1952, pp. 24-29, 72-73. Featuring illustrations by Chesley Bonestell, this was one of several articles written by von Braun, then technical director of the Army Ordnance Guided Missiles Development Group at the Redstone Arsenal in Huntsville, AL, to generate enthusiasm in the United States for a spaceflight program that would land humans on the Moon. This and related efforts were critical in increasing public belief in the possibility of reaching the Moon, although it took the launching of Sputnik by the Soviets to propel the United States to establish a space program and the election of John F. Kennedy as president to establish a landing on the Moon within a decade as the goal of the Apollo program. Here, von Braun provided details about a space station he envisioned as "either the greatest force for peace ever devised, or one of the most terrible weapons of war—depending on who makes and controls it." This evocation of the Cold War was characteristic of the times and proved a formidable tactic in generating support for U.S. space efforts. While he spoke of the possible use of the

station as a platform for the launching of atomic bombs, however, he also described peaceful, scientific uses of the station, such as meteorological observations.

Braun, Wernher von. "Man on the Moon: The Journey." *Collier's*. 18 October 1952, pp. 52-59. With illustrations by Chesley Bonestell, this was another of the articles von Braun wrote to promote the spaceflight movement. This particular article set forth in understandable terms many of the technological details von Braun expected a voyage to the Moon to involve. While some of them proved not to be prophetic, they were graphic and helped to grip the imaginations of the American public.

Braun, Wernher von, and Ordway, Frederick I., III. *Space Travel* (New York: Harper & Row, 1985). This update of *History of Rocketry & Space Travel* contains an excellent summary of the early visions of space flight and the execution of Project Apollo.

Bush, George. "Remarks by the President at 20th Anniversary of Apollo Moon Landing." National Air and Space Museum, July 20, 1989. Copy available in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. At this anniversary celebration, President Bush recalled the excitement of the Apollo 11 lunar landing and endorsed NASA's long-range plan, the Space Exploration Initiative, an ambitious effort that would return Americans to the Moon, establish a lunar base, and, then, using a NASA-built space station, send human expeditions to the planet Mars. In advancing SEI, Bush followed the classic script for exercising leadership in space. He made a Kennedy-like announcement, complete with a strong personal commitment, proposing the initiative during a major address commemorating the twentieth anniversary of the first landing on the Moon delivered from the steps of the National Air and Space Museum with the Apollo 11 astronauts at his side.

Cooke, Hereward Lester, with the collaboration of Dean, James D. *Eyewitness to Space: Paintings and Drawings Related to the Apollo Mission to the Moon Selected, with a Few Exceptions, from the Art Program of the National Aeronautics and Space Administration (1963 to 1969)*. Foreword by J. Carter Brown. Preface by Thomas O. Paine. New York: H.N. Abrams, 1971. A collection of 258 paintings and drawings in reproduction, created by a variety of artists ranging from Norman Rockwell to Chesley Bonestell. A magnificent and variegated collection.

Clarke, Arthur C. *The Exploration of Space*. New York: Harper & Brothers, 1951. In this book a senior science fiction writer provided both fiction and non-fiction in one of the more representative attempts to build realistic expectations of space travel. Although largely concerned with space technology, the sequence of chapters in this influential book laid out a blueprint for the future of space exploration that included a lunar landing on the Moon and eventual colonies.

\_\_\_\_\_. *Going Into Space*. Los Angeles: Trend Books, 1954. A soft-cover, well-illustrated, comic-like book laying out "thrilling material" on "man's interplanetary future" for "avid space enthusiasts." One of a number of easy-to-read "dime store" books on the future of space exploration that appeared in the 1950s and early 1960s. It emphasized the attraction of the Moon as a place to locate an Earth colony and as a jumping-off place to the remainder of the Solar System.

"Columbuses of Space." *New York Times*. December 22, 1968. This important editorial compares the flight of Apollo 8, the first circumlunar mission, to the first voyage of Christopher Columbus in 1492.

Crichton, Michael. *The Andromeda Strain*. New York: Alfred A. Knopf, 1969. Inspired by the failure of Biosatellite I in 1966, Crichton's fictional account of an alien organism run amok contributed to public concern about extraterrestrial contamination and NASA's decision to quarantine the first three astronaut crews to return from the Moon.

- Crouch, Tom D. "‘To Fly to the Moon’: Cosmic Voyaging in Fact and Fiction from Lucian to Sputnik." In Emme, Eugene M. Editor. *Science Fiction and Space Futures, Past and Present*. San Diego, CA: AAS History Series, Vol. 5, American Astronautical Society, 1982. Pp. 7-26. In this article Crouch traces the impact of science fiction on space pioneers like Robert H. Goddard.
- Disney Productions, Walt. *Man and the Moon*. 1955. Originally produced to promote the Disneyland theme park, this widely-viewed television program on "Walt Disney Presents" sported the powerful image of a wheel-like space station as a launching point for a mission to the Moon. This production included a cameo by Wernher von Braun who explained the technical details of a lunar landing mission. The episode deliberately sought to shape public opinion and influence government policy.
- Donovan, Robert J. "Moon Voyage Turns Men's Thoughts Inward." *Los Angeles Times*. December 29, 1968. This editorial reflects on the religious and spiritual significance of Apollo 8.
- Drury, Allen. *The Throne of Saturn*. Garden City, NY: Doubleday and Co., 1971. This work, appearing at essentially the same time as the Apollo 14 mission to the Moon, is a fictional story of the rivalry between the United States and the Soviet Union over space exploration. It focuses on the end of the Apollo program and the continuing race into space in the post-lunar landing era. Drury uses the novel to ask the question, why do humans need to be in space? He argues the issue back and forth, never giving a definitive answer.
- Durant, Frederick C., III, and Miller, Ron. *World's Beyond: The Art of Chesley Bonestell*. Norfolk: Donning, 1983. Bonestell's paintings helped to create realistic expectations of space between the 1940s and the 1960s. They were a powerful means of demonstrating to the public the reality of spaceflight that led to the Apollo decision.
- "Footprints in the Dirty Sand." *Washington Post*. December 28, 1968, p. A10. This editorial demonstrates that the wonders of the flight of Apollo 8 even impressed the normally critical editorial writers at the *Washington Post*.
- Goddard, Robert H. *A Method of Reaching Extreme Altitudes*. Washington, DC: Smithsonian Miscellaneous Collections, Volume 71, Number 2, 1919. In this monograph, one of the most important in his career, Goddard argued from a firm theoretical base that rockets could be used to explore the upper atmosphere. Moreover, he suggested that with a velocity of 6.95 miles/second, without air resistance, an object could escape Earth's gravity and head into infinity, or to other celestial bodies. He also suggested launching a rocket to the Moon with flash powder that would ignite on contact as a means of tracking it. Although Goddard refused to work with other scientists to develop American rocketry, remaining essentially a lone inventor, this paper and his example did help inspire others to follow in his footsteps.
- Goldstein, Lawrence. Editor. "The Moon Landing and its Aftermath." *Michigan Quarterly*. 8 (Spring 1979): 153-363. This collection of art, poems, letters, essays, and other articles takes up the entire issue. Together it could be described as a cultural reaction to Apollo 11 and the overall lunar landing program.
- Haggerty, James J. "Apollo: End of a Beginning—Will Mankind Nurture the Seed?" *Aerospace Perspectives*. 2 (March 1973): unpaginated. Discusses the general history of Apollo and then makes a case for the continuation of an aggressive space exploration program.
- Horrigan, Brian. "Popular Culture and Visions of the Future in Space, 1901-2001." In Sinclair, Bruce. Editor. *New Perspectives on Technology and American Culture*. (Philadelphia: The American Philosophical Society, 1986). Pp. 49-67. A sophisticated treatment of the influence of popular culture upon the space program, including Apollo, with treatment of science fiction in literature, the movies, and television.

Kasson, John. *Amusing the Millions*. New York: Hill and Wang, 1978. In 1903 the creators of "A Trip to the Moon" opened Luna Park, a fantasy-like setting, described in Kasson's book. Fifty million people visited the park in its first five years.

Kauffman, James Lee. "Selling Space: The Kennedy Administration, the Media, and Congressional Funding for Project Apollo, 1961-1963." Ph.D. Dissertation, Indiana University, 1989. This is a sophisticated discussion of the efforts by NASA and the White House to continue ensuring that sufficient public support was present for Project Apollo so that resources would be allocated to it by Congress. It deals only with the Kennedy administration, however, and therefore leaves out the most interesting part of this story, the efforts to keep the project moving forward expeditiously after its newness had worn off and after other priorities had emerged for which dollars were needed.

Kepler, Johann. *Kepler's Somnium: The Dream or Posthumous Work on Lunar Astronomy*. Translated by Edward Rosen. Madison: University of Wisconsin Press, 1967, pp. 17-122. Although technology did not develop to the extent that actual travel to the Moon could take place, for centuries people posited that it was theoretically possible and longed for the time when it would happen. When Galileo first broadcast his findings about the solar system in 1610, he sparked a flood of speculation about lunar flight. Johann Kepler, himself a pathbreaking astronomer, posthumously published a novel, *Somnium (Dream)* (1634), that recounted a dream of a supernatural voyage to the Moon in which the visitors encountered serpentine creatures. He also included much scientific information in the book, speculating on the difficulties of overcoming the Earth's gravitational field, the nature of the elliptical paths of planets, the problems of maintaining life in the vacuum of space, and the geographical features of the Moon.

Krug, Linda T., *Presidential Perspectives on Space Exploration: Guiding Metaphors from Eisenhower to Bush*. New York: Praeger, 1991. This important study assesses the use of language in building and maintaining support for aggressive space activities. The centerpiece of this study is the successful use of language to ensure that Project Apollo was carried out within the time constraints mandated by President Kennedy in 1961.

Krugman, Herbert E. "Public Attitudes Toward the Apollo Space Program, 1965-1975." *Journal of Communication*. 27 (Autumn 1977): 87-93. Results from a four-times yearly Trendex poll that surveyed support for the U.S. space program over the Apollo era. The poll found that less than half of the people in the U.S. supported the level of spending necessary to accomplish Project Apollo, but that an overwhelming number supported the idea of landing on the Moon.

Lasser, David. *The Conquest of Space*. New York: Penguin, 1931. This is the first realistic non-fiction book on space travel written in the English language. It was authored by the founder of the American Interplanetary Society. Lasser was also the first editor of *Amazing Stories*. One of the centerpieces of this book was a trip to the Moon.

Ley, Willy. *Rockets*. New York: Viking Press, 1944. A German emigré, Ley labored to convince interested readers that rockets would soon be able to carry humans off the surface of the Earth and to the Moon. This was one of the earliest books on rocketry for the general American public, serving as a basic reference source for future science fiction and reality writing.

Ley, Willy. *Rockets, Missiles, and Men in Space*. New York: Viking Press, 1968. This is the fourth and final edition of 21 printings of the work first published as *Rockets*. It emphasizes the possibilities of space flight as a reality rather than science fiction. Ley came to the U.S. in 1935, and this book became one of the most significant textbooks available in the mid-twentieth century on the possibilities of space travel. Once again, the book emphasizes the importance of a trip to the Moon as the first step by humanity off the Earth and into the universe.

- Ley, Willy, and Bonestell, Chesley. *The Conquest of Space*. New York: Viking Press, 1949. A best-selling book containing Bonestell's fantastic depictions of the Earth and the Moon. The oblique paintings of the Moon from lunar space gave the public a view remarkably like the one that NASA would provide more than a decade later after its first landing there with the Surveyor space probe.
- MacLeish, Archibald. "A Reflection: Riders on Earth Together, Brothers in Eternal Cold." *New York Times*, December 25, 1968. This is a poet's comments on the significance of seeing the Earth "as it truly is," during the Christmas flight of Apollo 8. MacLeish summed up the feelings of many people when he wrote at the time of the Apollo 8 circumlunar flight, that "To see the Earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the Earth together, brothers on that bright loveliness in the eternal cold—brothers who know now that they are truly brothers."
- "Man Will Conquer Space Soon." *Collier's*. March 22, 1952; plus October 18, 1952, October 25, 1952, February 28, 1953, March 7, 1953, March 14, 1953, June 27, 1953, April 30, 1954, and June 25, 1954. This famous *Collier's* magazine series of articles helped to build public interest in space exploration by declaring its "inevitability."
- Mazlish, Bruce. Editor. *The Railroad and the Space Program: An Exploration in Historical Analogy*. Cambridge, MA: MIT Press, 1965. This is an attempt to document the "social inventions" generated by the railroad in American history with those of the space program as manifested especially in Project Apollo. While the book deals largely with the development of railroads, they do not provide, Mazlish argues in the introduction, a useful comparison with the space program and therefore demonstrates the limitations of historical analogy.
- Michaud, Michael A.G. "The New Demographics of Space." *Aviation Space*. 2 (Fall 1984): 46-47. Updates to 1981 the results of polling on American support for the U.S. space program originally reported in the Krugman article.
- \_\_\_\_\_. *Reaching for the High Frontier: The American Pro-Space Movement, 1972-1984*. New York: Praeger, 1986. Michaud presents a cogent history of and commentary on the pro-space efforts made by voluntary organizations that arose near the end of the Apollo program. Michaud identifies the key groups, traces their origins and goals, and describes how they had a subtle but critical influence on the space policy of the nation during the late 1960s and early 1970s. These groups lobbied with Congress and used publicity to support the space effort, not always with the expected results, however. Their intent was to turn ideas and a diffuse pro-space sentiment into legislation aimed at building support for NASA's program. This book represents the first systematic attempt to analyze the space booster efforts of the latter 1960s and the 1970s, and although a fine contribution, it should not be the final word on the subject.
- Michener, James A. "Looking Toward Space." *Omni*. May 1980, pp. 57-58, 121. This fine article hits home to the heart of the American sense of pioneering and argues that the next great challenge in this arena is space. "A nation that loses its forward thrust is in danger," he comments; "the way to retain it is exploration" (p. 58). It is an eloquent and moving defense of the American space program in all its permutations.
- \_\_\_\_\_. "Manifest Destiny." *Omni*. April 1981, pp. 48-50, 102-104. An outstanding reading experience, this article, by the dean of American popular novelists, encapsulates all the most cherished principles for manned space flight. It is human destiny to explore, he notes, and space is the next logical path. He recounts the success of Apollo as the first step in humanity's movement beyond the Earth.
- Miller, Ron, and Durant, Frederick C., III. "Lunar Fantasies: The Story of the First Great Moon Expedition—of 1978." *Omni*. February 1987, pp. 50-55. This is a short summary of the lunar expedition outlined by von Braun and other writers for the *Collier's* series.

Mueller, George E. "The Space Program: Future Plans," delivered before the International Air Transport Association, Amsterdam, October 23, 1969. Available in the NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. In this classic but erroneous statement on the future of space exploration, the head of NASA's Office of Manned Space Flight predicted that more than 200 people would be living in space—in Earth and lunar orbit or on the Moon—by the mid-1980s.

Nicholson, Marjorie. *Voyages to the Moon*. New York: Macmillan, 1948. This little-known book describes the possibility of spaceflight and a landing on the Moon.

O'Neill, Gerard K. *The High Frontier: Human Colonies in Space*. New York: William Morrow, 1976. A tract by the leader of the space colonization movement, this book suggests that the U.S. should build on the success of Apollo with lunar colonies from which the rest of the Solar System could be explored.

Ordway, Frederick I., III, and Liebermann, Randy. Editors. *Blueprint for Space: Science Fiction to Science Fact*. Washington: Smithsonian Institution Press, 1992. This recent collection of articles by a wide range of contributors runs the gamut from visions of space flight to projections for the future. Most of the contributions are rather undetailed and consist mostly of overviews of their subjects, but they are written by such well-known figures as Ben Bova, Sam Moskowitz, Frank Winter, Ernst Stuhlinger, Fred L. Whipple, John M. Logsdon, Sally K. Ride, and Thomas O. Paine, as well as the editors, with Liebermann offering a discussion of "The *Collier's* and Disney Series," especially relevant to this section of the bibliography. There are also brief bibliographies at the ends of articles, and the book is lavishly illustrated.

Ordway, Frederick I., III; Adams, Carsbie C.; and Sharpe, Mitchell R. *Dividends from Space*. New York: Thomas Y. Crowell, 1972. This is an attempt to show that the costs of the space program have been more than returned in benefits to humanity, both tangible and intangible. The authors discuss at length the use of space systems to improve weather forecasting, facilitate communications, and inventory Earth resources. They also emphasize the development of the technological base with such major programs as Project Apollo.

Paine, Thomas O., "1969: A Space Odyssey," address to the American Institute of Aeronautics and Astronautics, Washington, DC, November 7, 1968. Copy available in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. This speech details the efforts of NASA to land astronauts on the Moon in 1969 from the perspective of the NASA administrator at the time.

\_\_\_\_\_. *Pioneering the Space Frontier: The Report of the National Commission on Space*. New York: Bantam Books, 1986. In 1984 Congress passed a bill requiring the president to name a National Commission on Space to develop a future space agenda for the United States. The White House in March 1985 chose Thomas O. Paine as chairman of the Commission. Since leaving NASA fifteen years earlier, Paine had been a tireless spokesman for an expansive view of what should be done in space. The fourteen other commissioners were a diverse group, ranging from Apollo 11 astronaut Neil Armstrong and test pilot Chuck Yeager to the U.S. Ambassador to the United Nations, Jeanne Kirkpatrick. After a year's study the Commission published a lavishly illustrated, glossy book endorsing "a pioneering mission for 21st-century America"—"to lead the exploration and development of the space frontier, advancing science, technology, and enterprise, and building institutions and systems that make accessible vast new resources and support human settlements beyond Earth orbit, from the highlands of the Moon to the plains of Mars." The report also contained a "Declaration for Space" that included a rationale for exploring and settling the Solar System and outlined a long-range space program for the United States.

Pendray, G. Edward. "Next Stop the Moon." *Collier's*. September 1946, pp. 11-13. Six years prior to the famous "Man Will Conquer Space Soon" series, this article argued that the Moon contained "riches beyond your wildest dreams" and advocated its exploration.

*Public Papers of the Presidents of the United States, Richard M. Nixon, 1969.* Washington, DC: Government Printing Office, 1971, p. 542. Nixon's statement that the Apollo 11 voyage was so significant that it constituted the greatest week in human history since the creation.

Pyne, Stephen J. "Space: A Third Great Age of Discovery." *Space Policy*. 4 (August 1988): 187-99. In this article, Pyne suggests that the world has known three great ages of exploration: (1) the circumnavigation of the globe, with its attendant discovery of new lands; (2) the traversing and cataloguing of newly-found continents; and (3) the exploration of the uninhabited regions of Antarctica, the deep ocean basins, and outer space. The author points to the culturally and historically determined nature of discovery, which has thus far been largely a Western phenomenon, but emphasizes the qualitatively different character of space exploration, which takes the Earth, rather than any particular part of it, as its starting point, and which sets forth to chart regions that are probably abiotic.

Redford, Emmette, and White, Orion F. *What Manned Space Program After Reaching the Moon? Government Attempts to Decide, 1962-1968.* Syracuse, NY: The Inter-University Case Program, January 1971. Limited edition study of the efforts of NASA and other government agencies to determine what policies and programs it should pursue for the future space program. It is especially helpful as a statement of where leaders thought the U.S. should be going at the very time the debate over NASA's goals after Apollo was taking place.

"Return from the Moon." *New York Times*. December 28, 1968. A *Times* editorial in which the writers called Apollo 8 "the most fantastic voyage of all times."

Roberts, Christopher B. "NASA and the Loss of Space Policy Leadership." *Technology in Society*. 12 (1990): 139-55. Since the days of Apollo, NASA's efforts have consistently exceeded the willingness of the political consensus to provide adequate funding. As a result of the failure of U.S. leadership, including that within NASA, to fully comprehend the political dimensions of the space program, the U.S. effort has drifted and the nation lost the commanding role it had with the success of Apollo. In this chapter, the author develops a new analytical framework for NASA's development and management of the space program, focusing on the dominance of bureaucratic goals over program goals.

Roland, Alex. "Barnstorming in Space: The Rise and Fall of the Romantic Era of Spaceflight, 1957-1986." In Byerly, Radford, Jr. Editor. *Space Policy Reconsidered*. Boulder, CO: Westview Press, 1989. Pp. 33-52. In this article Alex Roland, a leading critic of NASA's human spaceflight program, argues that NASA is wedded to a large and expensive astronaut program, despite budgetary and program realities, because of its longstanding vision of what the space program should be. Roland asserts that in the post-Challenger era since 1986 the U.S. is between the first and second stages of spaceflight. In that first stage, the romantic "barnstorming" stage of rollicking excitement and wasted energies, the focus was on the initial departure from planet Earth. A centerpiece of that romantic era of spaceflight, marked as it was by a series of specular events, was Project Apollo and the landing on the Moon. The second stage is undefined, but Roland contends that it will be different from the earlier era and marked by gradual development and practical application of space technology.

Ryan, Cornelius. Editor. *Conquest of the Moon*. New York: Viking Press, 1953. Expanded version of a series of scientific articles that appeared in *Collier's* under the title "Man on the Moon" in 1952. Includes articles by Willy Ley, Wernher von Braun, and Fred Whipple, as well as illustrations by Chesley Bonestell.

Sharpe, Mitchell R. *Living in Space: The Astronaut and his Environment*. Garden City, NY: Doubleday and Co., 1969. Discusses biomedical and psychological aspects of spaceflight as well as the perils and advantages of doing it. Presents a strong argument for expanding human spaceflight through a rigorous Apollo program and aggressive efforts thereafter.

- Shea, Joseph F. "Manned Space Flight Program," address delivered at the Third National Conference on the Peaceful Uses of Space, May 6, 1963, NASA News Release. Copy available in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. The Deputy Director of NASA's Office of Manned Space Flight considers space exploration as a matter of national survival and applauds President Kennedy's decision to undertake Project Apollo on an aggressive timetable.
- Shelton, William R. "Science and Fantasy, A Chronicle of Space." In Shelton, William R. *Man's Conquest of Space*. Washington, DC: National Geographic Society, 1968. Shelton recounts the events and people that have inspired space flight on the eve of the Apollo expeditions to the Moon.
- Sidey, Hugh. "Pioneers in Love with the Frontier." *Time*. 10 February 1986, pp. 46-47. This thoughtful discussion of the development of the U.S. space program emphasizes the role of the frontier and the exploration imperative in the United States. Sidey, an extremely articulate commentator, suggests that nothing worthwhile is gained without sacrifice. This was a response to the naysayers of the space program after the January 1986 Challenger accident but emphasizes the 1961 Apollo decision of President Kennedy as the quintessential statement of a vision of exploring the unknown.
- Smith, Michael L. "Selling the Moon: The U.S. Manned Space Program and the Triumph of Commodity Scientism." In Fox, Richard Wrightman, and Lears, T.J. Jackson. Editors. *The Culture of Consumption: Critical Essays in American History*. New York: Pantheon Books, 1983. Pp. 177-209. Part of a larger collection about advertising and American culture, this article analyzes the role of NASA, the aerospace industry, and political leaders in building support for Project Apollo. The author asserts that Apollo provides a useful vehicle for analyzing the evolution of consumer culture in the 1960s. Its social function, its publicists, and the form of presentation approximated those of the most highly developed communication medium in American culture: advertizing. In the process the program accomplished its purpose; it articulated to the world "an image of national purpose [in the U.S.] that equated technological preeminence with military, ideological, and cultural supremacy" (p. 177).
- Smith, Ralph A. *The Exploration of the Moon*. London: Frederick Muller, Ltd., 1954. With text by Arthur C. Clarke. In this popular work on space, paintings by British artist Ralph Smith dominated the book, with Arthur Clarke arguing that "there are no insuperable obstacles on the road to the planets" and asserting that an aggressive space exploration should begin with trips to the Moon.
- Thomas, Davis. Editor. *Moon: Man's Greatest Adventure*. New York: H.N. Abrams, 1970. A large-format, illustrated work, the centerpiece of this book consists of three major essays. One, by Fred A. Whipple, Harvard University astronomer, describes the possibilities of space flight for scientific inquiry. Another by Silvio A. Bedini, at the Smithsonian Institution, deals with the Moon's role in human affairs. A final article by Wernher von Braun of NASA analyzes Project Apollo and its execution in the 1960s.
- "Topics of the Times." *New York Times*. January 13, 1920, p. 12. Reprinted in Clarke, Arthur C. Editor. *The Coming of the Space Age*. New York: Meredith Press, 1967. This is a *New York Times* editorial that was written in response to Robert H. Goddard's 1919 Smithsonian Institution publication, *A Method of Reaching Extreme Altitudes*. It doubts that Goddard's rockets could be used to reach the Moon, since according to the *Times* editorial writers, there is no air in space against which the rocket could push. It referred to Goddard as a dreamer whose ideas had no scientific validity. It also compared his theories to those advanced by novelist Jules Verne, indicating that such musing is "pardonable enough in him as a romancer, but its like is not so easily explained when made by a savant who isn't writing a novel of adventure." The *Times* also questioned both Goddard's credentials as a scientist and the Smithsonian's rationale for funding his research and publishing his results.

Verne, Jules. *De la Terre à la Lune (From the Earth to the Moon)*. Paris: J. Hetzel, 1866. This is a pathbreaking work of science fiction that incorporated a more sophisticated understanding of the realities of space flight than had been seen before. His space vehicle was enclosed and powered by electricity, and it possessed some aerodynamic soundness. This book described the problems of building a vehicle and launch mechanism to visit the Moon. At the end of the book, Verne's characters were shot into space by a 900-foot-long cannon. Verne picked up the story in a second novel, *Autour de la Lune (Around the Moon)*, describing a lunar orbital flight, but he did not allow his characters actually to land.

Von Braun, Wernher, and Ryan, C. "Can We Get To Mars?" *Colliers*. 30 April 1954, pp. 22-29. During the Second World War German scientists, including Wernher von Braun, began testing spacecraft models based on Sänger's concepts as well as theories of their own. This article popularized the idea of a reusable earth-to-orbit space transportation system.

Wells, H.G. *The First Men in the Moon*. London: George Newness, 1901. This is a pioneering work of science fiction that described in detail the method of reaching the Moon and encounters with aliens there.

Wilson, Charles Reagan. "American Heavens: Apollo and the Civil Religion." *Journal of Church and State*. 26 (Spring 1984): 209-26. Applying the concept of American civil religion—a set of values and ethical beliefs—to Project Apollo, the author finds that the effort revealed an important link between science and technology, religion, and American self-understanding. He suggests that Apollo participants tied religion and science together in a surprising way. He concluded: "One sees elements of both a rational religion, which can be traced back to the Enlightenment, and an evangelical religion, which has been the nation's culturally dominant religious force through most of American history" (p. 210). Wilson explores the intriguing questions of rhetoric and belief, ritual and symbolism within the context of the U.S. Apollo program.

Wright, Mike. "The Disney-Von Braun Collaboration and Its Influence on Space Exploration." In Schenker, Daniel; Hanks, Craig; Kray, Susan. Editors. *Inner Space, Outer Space: Humanities, Technology, and the Postmodern World*. Huntsville, AL: Southern Humanities Conference, 1993, pp. 151-60. This is a solid discussion of the role of Walt Disney and Wernher von Braun in promoting space exploration in the 1950s through a series of three segments on Disney's weekly television program. The second of these segments dealt with a human flight to the Moon.



*Landing Site 2 on the Moon as photographed from the Apollo 11 lunar module. NASA photo 69-H-1042.*

# CHAPTER 7

## SCIENCE

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Adler, I., et al. "Apollo 16 Geochemical X-Ray Fluorescence Experiment: Preliminary Report." *Science*. 177 (21 July 1972): 256-59. This is a technical study of a particular experiment conducted as part of the Apollo program.

*Analysis of Surveyor 3 Material and Photographs Returned by Apollo 12*. Washington, DC: NASA SP-284, 1972. A sophisticated scientific investigation, in 295 pages, of the Surveyor 3 data.

(Apollo 11 Lunar Science Results). *Science*. 167 (30 January 1970): (entire issue), 336 pp. This issue contains many individual articles on various aspects of lunar science.

*Apollo 11: Preliminary Science Report*. Washington, DC: National Aeronautics and Space Administration SP-214, 1969. Issued within months of the first lunar mission, this report gleans some of the major findings from the scientific instruments used and experiments conducted in July 1969.

Apollo 15 Preliminary Examination Team. "The Apollo 15 Lunar Samples: A Preliminary Description." *Science*. 175 (28 January 1972): 363-75. A scientific discussion of the samples returned from Hadley Rille and the Apennine Mountains where Apollo 15 conducted its mission. During this mission the astronauts discovered what has been called the "Genesis Rock," a sample of ancient lunar crust of great geological interest.

Apollo Field Geology Investigation Team. *Preliminary Geologic Investigation of the Apollo 16 Landing Site*. Washington, DC: U.S. Dept. of the Interior, Geological Survey, 1972. This study traces the major investigations of Apollo 16 astronauts in the Descartes highland region of the Moon. Based on their geologic investigations, scientists found that a region previously thought to be volcanic turned out not to be.

Apollo Lunar Geology Investigation Team. "Geologic Setting of the Apollo 15 Samples." *Science*. 175 (28 January 1972): 407-15. A scientific discussion of the geologic area where the Apollo 15 samples were recovered, including a discussion of the "Genesis Rock," a sample of ancient lunar crust of considerable geological interest.

"Apollo Lunar Surface Experiments Package." *Space World*. November 1969, pp. 4-18. This is a lay-oriented discussion of the scientific equipment placed on the Moon during Apollo 11 and some of the proposed experiments to be placed on the surface in future missions.

"Apollo's Scientific Objectives." *Space World*. August 1969, pp. 4-17. This is a lengthy discussion of the overall philosophy and method of accomplishment of the major scientific experiments to be conducted on the lunar surface. One of the major objectives was to discover the origins of the Moon and to lay to rest a series of internecine struggles between space scientists with opposing theories. The data from the lunar missions failed to bring about any true consensus on this contentious issue although it did point to interesting revisions of the debate about origins.

*Apollo-Soyuz Test Project: The Apollo-Soyuz Test Project Medical Report*. Springfield, VA: National Technical Information Service, 1977. This short publication, 129 pages, is an illustrated discussion of the biomedical results from this space flight, using both U.S. and U.S.S.R. flight data.

*Apollo-Soyuz Test Project Preliminary Science Report*. Washington, DC: National Aeronautics and Space Administration, 1976. In 529 pages, this loose-leaf report discusses the entire range of scientific experiments and results from the 1975 international mission with the Soviet Union.

Baldwin, Ralph Belknap. *The Face of the Moon*. Chicago: University of Chicago Press, 1949. This is an important encapsulation of several centuries of research about the Moon—a basic primer on the subject written before the launch of the first lunar probes. As such, it provides a basis of comparison with later findings.

\_\_\_\_\_. *Fundamental Survey of the Moon*. New York: McGraw-Hill, 1965. An important description of lunar science through the beginning of the space age.

\_\_\_\_\_. *The Measure of the Moon*. Chicago: University of Chicago Press, 1963. Another important description of information about the Moon as known at the time.

Baldwin, Ralph B., and Wilhelms, Don E. "Historical Review of a Long Overlooked Paper by Reginald A. Daly Concerning the Origin and Early History of the Moon." *Journal of Geophysical Research*. 97 (25 March 1992): 3837-43. One of the most hotly contested debates in space science has been the origin of the Moon. The Apollo program did not resolve the debate, and competing theories still abound. This is the most recent entry into the debate, looking at a paper by an early scientist dealing with the issue.

Berry, C.A. "Summary of Medical Experience in the Apollo 7 Through 11 Manned Spaceflights." *Aerospace Medicine*. 41 (May 1970): 500-19. This is a sophisticated scientific paper describing the results of biomedical experiments during the early history of Apollo. It is especially helpful in discussing the problem of radiation and other effect on the astronauts during the missions to the Moon of Apollo 8 and 11.

Bless, Robert. "Space Science: What's Wrong at NASA." *Issues in Science and Technology*. 5 (Winter 1988-1989): 67-73. Not specifically concerned with Apollo, Bless' analysis of the problems of NASA nevertheless includes that program. He uses the dichotomy between human space flight programs and satellite efforts as examples of how not to manage programs and concludes that the problems are historically rooted in the agency's emphasis on astronauts.

Bluck, John. *Journey Through the Solar System: Lesson Guide, a 13 Part Series*. Cleveland, OH: Lewis Research Center, 1987. This 60-page, large-size monograph is an educational publication designed to provide information for secondary school teachers and students about Solar System science. One of the segments deals with lunar science, including the all important question of the Moon's origin.

Bogard, D.D. "Noble Gas Abundances in Lunar Material: Cosmic Ray Spallation Products and Radiation Ages from the Sea of Tranquility and the Ocean of Storms." *Journal of Geophysical Research*. 76 (10 April 1971): 2757-79. This lengthy scholarly article describes the results of geological research in the Sea of Tranquility and the Ocean of Storms that resulted from the explorations of Apollo 11 and Apollo 12.

Brush, Stephen G. "Early History of Selenogony." In *Origin of the Moon*. Edited by Hartmann, William K.; Phillips, R.G.; and Taylor, G.J. Houston, TX: Lunar and Planetary Institute, 1986. Pp. 3-15. This article describes the debate over the origins of the Moon from the sixteenth century to the 1930s. Selenogony—the theory of origins of the Moon—was hotly debated during this era, but no definitive answers could be provided because the evidence required for a rigorous test of competing theories was obtained only with the lunar landings of Project Apollo.

- \_\_\_\_\_. "A History of Modern Selenogony: Theoretical Origins of the Moon from Capture to Crash 1955-1984." *Space Science Reviews* 47 (1988): 211-73. This important article traces the scientific debate about the origins of the Moon during the first three decades of the Space Age. In the 1950s G.H. Darwin's fission was still occasionally mentioned but by the 1960s it had been displaced by the hypothesis of lunar capture. A few scientists favored formation of the Moon from particles in order around a growing Earth. Analysis of samples from the Apollo missions did not confirm any of these three theories of lunar origin. Eventually the giant impact theory, proposed by scientists W.K. Hartmann and D.R. Davis (1974) and by A.G.W. Cameron and W.R. Ward (1975), was adopted as the best working hypothesis. But the question was not satisfactorily solved and other theories are still being actively pursued.
- \_\_\_\_\_. "Nickel for Your Thoughts: Urey and the Origin of the Moon." *Science*. 217 (3 September 1982): 891-98. This important article describes in detail the theories of Harold C. Urey on the origin of the Moon. Brush compares them to earlier ideas, especially those of George Howard Darwin's fission hypothesis. Urey's espousal of the idea that the Moon had been captured by the Earth and has preserved information about the earliest history of the Solar System led him to advocate a manned lunar landing program. Results from the Apollo missions, in particular the deficiency of siderophile elements in the lunar crust, led him to abandon the capture selenogony and tentatively adopt the fission hypothesis.
- \_\_\_\_\_. "Theories of the Origin of the Solar System 1956-1985." *Reviews of Modern Physics*. 62 (January 1990): 43-112. This article describes efforts to find a plausible naturalistic explanation of the origin of the Solar System. During the period discussed, the first extensive field research was undertaken and this has brought about the development of several important theories of origins. During this period most scientists accepted the collapse of a gas-dust cloud to form the Sun with surrounding disk, and condensation of that disk to form planets. Theorists differed on how to explain the distribution of angular momentum between the Sun and the planets, on whether planets formed directly by condensation of gaseous protoplanets or by accretion of solid planetesimals, on whether the "solar nebula" was ever hot and turbulent enough to vaporize and completely mix its components, and on whether an external cause such as a supernova explosion set in motion the gas cloud's collapse.
- Buffalano, C. "A Physical Model of the Apollo Oxygen Releases." *Journal of Geophysical Research*. 76 (1 January 1971): 27-35. This scientific paper provides an analysis of oxygen release discovered as a result of the Apollo lunar flights.
- Bunch, T.E.; Prinz, Martin; and Keil, Klaus. *Electron Microprobe Analyses of Lithic Fragments and Glasses from Apollo 12 Lunar Samples*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1972. Institute of Meteoritics Special publication no. 4. A basic report of scientific analysis of the samples collected during the November 1969 Apollo 12 mission to the Ocean of Storms.
- Burrows, William E. *Exploring Space: Voyages in the Solar System and Beyond*. New York: Random House, 1990. A popular history, but a cut above the average, of the efforts to send probes to the planets, moons, and asteroids of the Solar System, this book does not dwell on project Apollo. It contains a solid chapter on Project Ranger, much of it apparently a summary of R. Cargill Hall's *Lunar Impact* book, and other discussions of lunar probes and the scientific results about the Moon that came from Apollo. The book's major drawback is its sometimes uncritical nature and lack of formal scholarly apparatus.
- Catalogue of Apollo 15 Rake Samples from Stations 2 (St. George), 7 (Spur Crater), and 9a (Hadley Rille)*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1973. This 75-page illustrated monograph simply catalogs the lunar samples taken from specific sites during the Apollo 15 mission of July-August 1971.

*Catalogue of Apollo 17 Rake Samples from Stations 1A, 2, 7, and 8.* Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1978. This 88-page illustrated monograph simply catalogs the lunar samples taken from specific sites during the Apollo 17 mission of December 1972, the last landing on the Moon.

Comstock, G.M., et al. "Cosmic-Ray Tracks in Plastics: The Apollo Helmet Dosimetry Experiment." *Science*. 172 (9 April 1971): 154-57. A straight-forward description of this experiment.

Cooper, Henry S.F. *Moon Rocks*. New York: Dial Press, 1970. This is an informal account of the first investigating team's examining the lunar samples at Houston. Like everything that Cooper writes, it is very personal and descriptive of meetings that he attended with the scientific team working on the project. It is filled with interesting personality sketches and anecdotes of the intense effort to provide the first scientific assessment of the lunar samples.

Davies, J.E. "Preliminary Examination of the Apollo 12 Lunar Samples." *Spaceflight*. 13 (January 1971): 24-29. A straight-forward description of scientific analysis of the samples collected during the November 1969 Apollo 12 mission to the Ocean of Storms.

Dowty, Eric, et al. *Electron Microprobe Analyses of Minerals from Apollo 15 Mare Basalt Rake Samples*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1973. This monograph describes the lunar samples taken from specific sites during the Apollo 15 mission of July-August 1971, the first mission to use the lunar rover to travel widely in the vicinity of the landing site.

\_\_\_\_\_, et al. *Electron Microprobe Analyses of Minerals from Apollo 16 Rake Samples*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1976. This monograph describes the lunar samples taken from specific sites during the Apollo 16 mission of April 1971.

Dyal, P., and Parkin, C.W. "The Magnetism of the Moon." *Scientific American*. 225 (August 1971): 62-73. This paper documents the studies of the Moon's magnetic field. The evidence suggests that while the Moon has no magnetic field today, it probably had a strong one in the past. This is based on an analysis of lunar samples that suggest the Moon's field was somehow turned off about 3 billion years ago.

El-Baz, Farouk. *Astronaut Observations from the Apollo-Soyuz Mission*. Washington, DC: Smithsonian Institution Press, 1977. This volume consists partly of text, partly of extensive photographs and maps of the Earth taken by astronauts on their training flights for the mission or taken on board the spacecraft to support the Earth Observations and Photography Experiment conducted during the mission. Another portion of the text consists of verbal comments made by American astronauts regarding that experiment. The remaining 122 pages of text consists of discussions of the scientific objectives of the mission, astronaut training, flight planning, mission operations, and a summary of the scientific findings of the mission in the areas of geology, oceanography, hydrology, meteorology, and environmental science.

*Electron Microprobe Analyses of Lithic Fragments, Glasses, Chondrules, and Minerals in Apollo 14 Lunar Samples*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1973. This short, 38-page monograph describes the lunar samples taken from specific sites during the Apollo 14 mission of January-February 1971.

Elston, Wolfgang E. "How Did Impact Processes on Earth and Moon Become Respectable in Geologic Thought?" *Earth Sciences History*. 9 (1990): 82-87. A short, useful discussion of the development of procedures and theories about cratering on both the Moon and the Earth.

- Esenwein, George F.; Roberson, Floyd I.; and Winterhalter, David L. "Apollo in Lunar Orbit." *Astronautics & Aeronautics*. 9 (April 1971): 52-63. Remote-sensing instruments and cameras for the remaining Apollo missions shaped a broad interdisciplinary approach to lunar science that encompassed selenodesy, geophysics, geochemistry, geology, cartography, and particles and fields. This article discusses science on the remaining three Apollo missions and sums up what had already been done.
- Firsoff, Valdemar A. *The Old Moon & the New*. South Brunswick: A.S. Barnes, 1970. This book, written for a general audience, discusses the development of lunar theory and describes its changes as a result of the Apollo missions then under way.
- French, Bevan M., et al. *Compositions of Major and Minor Minerals in Five Apollo 12 Crystalline Rocks*. Washington, DC: National Aeronautics and Space Administration, 1972. A sophisticated analysis of lunar samples returned from the Ocean of Storms by the Apollo 12 crew.
- \_\_\_\_\_. Editor. *The Moon Book: Exploring the Mysteries of the Lunar World*. New York: Penguin, 1977. This book, written by a senior NASA scientist involved in lunar studies, describes the discoveries made about the Moon as a result of the lunar landings.
- \_\_\_\_\_. "Space Rocks: Getting Our Hands on the Universe." *Air & Space*. Fall 1980, pp. 3-5. Written for the non-specialist, this article describes in general terms the basic development of the Moon and meteorites using as a hook the rock samples that Apollo returned and the meteorite rocks that hit the Earth.
- \_\_\_\_\_. *What's New on the Moon?* Washington, DC: NASA EP-131, 1976. This short booklet is written as a series of questions and answers for secondary school students about the Moon. Such questions as "Is there life on the Moon?" and "What is the Moon made of?" are followed by answers phrased in non-technical language. This is a good basic primer about lunar science based on scientific investigations supported by Apollo.
- Froehlich, Walter. *Apollo 14: Science at Fra Mauro*. Washington, DC: National Aeronautics and Space Administration, 1971. A 48-page illustrated study, this monograph describes in lay terms the activities and scientific results of the January-February 1971 flight of Apollo 14.
- \_\_\_\_\_. *Apollo 16 at Descartes*. Washington, DC: National Aeronautics and Space Administration, 1972. A 32-page illustrated study, this monograph describes in lay terms the activities and scientific results of the April 1971 flight of Apollo 16.
- Ganapathy, R., et al. "Apollo 12 Lunar Samples: Trace Element Analysis of a Core and the Uniformity of the Regolith." *Science*. 170 (30 October 1970): 533-35. An early scientific discussion of the lunar sample analysis from Apollo 12 at the Ocean of Storms.
- \_\_\_\_\_, et al. "Moon: Possible Nature of the Body that Produced the Imbrian Basin, from the Composition of Apollo 14 Samples." *Science*. 175 (7 January 1972): 55-59. Another discussion of the lunar samples, this time from Apollo 14.
- Geology of the Apollo 14 Landing Site in the Fra Mauro Highlands*. Reston, VA: Dept. of the Interior, Geological Survey, 1977. This monograph presents a scientific discussion of the samples returned by Apollo 14 and how they relate to the overall geologic development of the region.
- The Great Project: Space Exploration and the Apollo Program, Scientific Insights and Tangible Benefits Derived for Mankind*. Oberkochen/Wurt., West Germany: Carl Zeiss in cooperation with the Bonn Office of the United States Information Service, 1971. This 140-page illustrated study summarized the major

scientific findings resulting from Project Apollo. The book was designed for an international audience and placed the most positive spin on all of the scientific activities of the effort.

Gregory, William H. "Lunar Photos Reveal New Details." *Aviation Week and Space Technology*. 20 December 1971, pp. 66-77. This rather detailed account of new information about lunar volcanism revealed by Apollo 15 photographs of the Moon includes a number of photographs and a schematic drawing.

Grodzka, P.G., and Bannister, T.C. "Heat Flow and Convection Demonstration Experiments Aboard Apollo 14." *Science*. 176 (5 May 1972): 506-508. A straightforward scientific discussion of these experiments.

Hammond, A.L. "Lunar Research: No Agreement on Evolutionary Models." *Science*. 175 (25 February 1972): 868-70. This article summarizes the results of the scientific studies of the Moon, the place of Project Apollo in them, and the disagreements between scientists over lunar origins and evolution.

Hanle, Paul A. and Chamberlain, Von Del. Editors. *Space Science Comes of Age: Perspectives in the History of the Space Sciences*. Washington, DC: Smithsonian Institution Press, 1981. An important book with a series of articles by different specialists, it has chapters by Robert Jastrow ("Exploring the Moon"); Eugene Shoemaker ("Lunar Geology"); Stephen G. Brush ("From Bump to Clump: Theories of the Origin of the Solar System, 1900-1960"); and Homer G. Newell ("Continuing Harvest: The Broadening Field of Space Science") that relate to the lunar science conducted as part of Project Apollo.

Harada, K., et al. "Evidence for Compounds Hydrolyzable to Amino Acids in Aqueous Extracts of Apollo 11 and Apollo 12 Lunar Fines." *Science*. 173 (30 July 1971): 433-35. Scientific analysis of this subject.

Hartmann, William K. *Moons and Planets*. Belmont, CA: Wadsworth, 1983. Originally published in 1972, this book reflects the lunar science conducted during Project Apollo in its analysis of the Moon.

\_\_\_\_\_. *History of the Lunar Surface*. Tucson: University of Arizona Press, 1966. A useful discussion of the development of the Moon written after the first probes had been sent there but before the lunar landings.

Head, J.W., III. "Lunar Volcanism in Space and Time." *Reviews of Geophysics and Space Physics*. 14 (May 1976): 265-300. This lengthy article examines the role of lunar volcanism as revealed from lunar-orbit and Earth-based data plus characterizations derived from lunar samples brought back on Apollo missions. The author concludes, among other findings, that there is little conclusive evidence for highland volcanism on the Moon; that lunar mare lavas seem to have originated at depths of 100 to 500 km.; that mare volcanism occurred from 3.83 to roughly 2.5 billion years ago; and that a thicker farside crust perhaps is responsible for the asymmetry between mare deposits on the near and far sides of the Moon.

Heiken, Grant H.; Vaniman, David T.; and French, Bevan M. Editors. *The Lunar Sourcebook*. New York: Cambridge University Press, 1991. This book's virtue is that it condenses into a useable form information from the U.S. and Soviet missions to the Moon in a reference work. It explores the formation and evolution of the Moon's surface, the chemical and mineralogical nature of lunar rocks and soils, and the current state of scientific knowledge about the nature, origin, and history of the Moon.

Hess, W., et al. "The Exploration of the Moon." *Scientific American*. 221 (October 1969): 54-60, 66-70, 72. A general overview of the lunar science underway and Apollo's contribution to it.

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It finds that by the middle part of the 1960s NASA had gained suzerainty over the majority of the resources and could therefore direct the major science projects along paths that seemed most logical to the agency.

- Hlava, Paul F., et al. *Apollo 15 Rake Sample Microbreccias and Non-Mare Rocks: Bulk Rock, Mineral and Glass Electron Microprobe Analyses*. Albuquerque, NM: Department of Geology & Institute of Meteoritics, University of New Mexico, 1973. This monograph analyzes the lunar samples taken from specific sites during the Apollo 15 mission of July-August 1971.
- Jaffee, L.D. "Lunar Surface: Changes in 31 Months and Micrometeoroid Flux." *Science*. 170 (4 December 1970): 1092-95. A study of the lunar surface, finding change over time.
- Johnson, Nicholas L. *Handbook of Soviet Lunar and Planetary Exploration*. Science and Technology Series, vol. 47. San Diego, CA: Univelt, 1979. An encyclopedic approach to Soviet science of the space age, but now outdated because of the information presently available as a result of the end of the Cold War.
- Johnston, Richard S.; Dietlein, Lawrence F.; and Berry, Charles A. Editors. *Biomedical Results of Apollo*. Washington, DC: NASA SP-368, 1975. This straightforward volume ranges in its coverage from crew health and inflight monitoring to inflight experiments on the Apollo missions with a useful section on the technology used for such everyday concerns as supplying astronauts with food, water, and waste management in space. A useful section at the end sums up what life scientists learned from Apollo.
- King, Elbert A. *Moon Trip: A Personal Account of the Apollo Program and Its Science*. Houston, TX: University of Houston, 1989. This short memoir describes the scientific work on the lunar samples returned by the Apollo missions. King, a geologist and first curator of the returned lunar samples, worked at the NASA Manned Spacecraft Center in Houston as part of the in-house scientific group that planned for scientific lunar exploration, astronaut training, and care and analysis of the returned samples.
- Kopal, Zdenek. *Exploration of the Moon by Spacecraft*. Edinburgh, Scotland: Oliver & Boyd, 1968. This study describes the satellite probe missions to the Moon conducted in anticipation of the Apollo landings.
- \_\_\_\_\_. *The Moon in the Post-Apollo Era*. Dordrecht, Holland: D. Reidel, 1974. A careful scientific study of the Moon incorporating the findings from the research conducted as part of Project Apollo.
- \_\_\_\_\_. *The Moon*. Dordrecht, Holland: D. Reidel, 1969. A solid scientific treatise on the origins, geomorphology, and physiology of the Moon written at the time of the first lunar landings.
- \_\_\_\_\_, and Carder, R.W. *Mapping of the Moon: Past and Present*. Boston: Reidel, 1974. A basic study of the lunar surface; takes a historical perspective.
- Kuiper, Gerard P., and Middlehurst, Barbara M. Editors. *The Moon, Meteorites, and Comets*. The Solar System, Vol. 4. Chicago: University of Chicago Press, 1963. A standard work on the subject written by one of the most influential of the lunar and solar system scientists working during the Apollo era.
- Kvenvolden, K.A., and Ponnampereuma, C. Editors. *A Search for Carbon and its Compounds in Lunar Samples From Mare Tranquillitatus*. Washington, DC: NASA SP-257, 1970. A discussion of the scientific efforts to determine the extent to which carbon was present in rock and soil samples at the landing site of Apollo 11. The presence of carbon would help to determine the origin of the Moon and its relationship to Earth. The scientists found little evidence of carbon.

- Latham, G., et al. "Seismic Data From Man-Made Impacts on the Moon." *Science*. 170 (6 November 1970): 620-26. This scientific paper measured the amount of seismic activity at lunar landing sites using data coming from the Apollo expeditions.
- Lauderdale, W.W., and Eichelman, W.F. Editors. *Apollo Scientific Experiments Data Handbook*. Houston, TX: Lyndon B. Johnson Space Center, NASA TM X-58131, 1974. A basic reference tool for scientists studying data returned from Project Apollo.
- Levinson, A.A. Editor. *Proceedings of the Apollo 11 Lunar Science Conference, Houston, Texas, 1970*. New York: Pergamon Press, 1970. 3 vols., 2492 pp. This lengthy set of books contains papers presenting the latest findings about lunar science based on the data provided by Apollo 11 and earlier lunar observations.
- \_\_\_\_\_. Editor. *Proceedings of the Second Lunar Science Conference*. Cambridge, MA: The MIT Press, 1971. 3 vols., 2818 pp. Papers presenting the latest findings about lunar science based on the data provided by Apollo missions and earlier lunar observations.
- \_\_\_\_\_, and Taylor, S.R. *Moon Rocks and Minerals*. New York: Pergamon Press, 1971. This evaluation of the important findings resulting from the initial study of lunar rocks from Apollo 11 covers four general topics: mineralogy and petrology, chemical and isotope analysis, bioscience and organic geochemistry, and physical measurements and properties. The book discusses the absence of organic matter in the lunar samples' rock textures as compared with those on Earth, the importance of these samples in revealing the history and origin of the Moon, and a variety of shock studies to ascertain the results of impacts upon trace elements, the lunar surface, radiation effects, and rare gases.
- Lichtenstein, Bernard Robert. "Apollo 15 and 16 Subsatellite Magnetometer Measurements of Solar Wind and Magnetospheric Plasma Interactions with the Moon." Ph.D. Diss., UCLA, 1978. Presentation of data on the solar wind based on Apollo data.
- Light, D.L. "Photo Geodesy From Apollo." *Photogrammetric Engineering*. 38 (June 1972): 574-87. A discussion for a non-scientific audience of the use of Apollo photography to advance geological and geographical information about the Moon. Heavy emphasis on equipment and how it was used.
- "Lunar Exploration." *Astronautics & Aeronautics*. (January 1969): 32-74. This is a special section with the following articles: Homer J. Stewart, "Lunar Exploration—the First Decade Raises more Questions than it Answers," pp. 32-36; Harold C. Urey, "The Contending Moons," pp. 37-41; Harold Masursky, "Lunar-Exploration Targets," pp. 43-49; Albert R. Hibbs, "Surveyor Results," pp. 50-63; James E. Conel, "What the Rangers Revealed About Lunar Geology," pp. 64-68; Thomas C. Rindfleisch, "Getting More Out of Ranger Pictures by Computer," pp. 70-74.
- Lunar Geoscience Working Group. *Status and Future of Lunar Geoscience*. Washington, DC: NASA SP-484, 1986. An important statement of where lunar science stood as of 1986 and an agenda for future possibilities. It gives considerable credit to the explorations of the Moon supported through Project Apollo for advances in the field.
- Lunar Sample Preliminary Examination Team. "Preliminary Examination of Lunar Samples From Apollo 14." *Science*. 173 (20 August 1971): 681-93. A straight-forward description of scientific analysis of the samples collected during the January-February 1971 Apollo 14 mission to Fra Mauro.
- Lyndon B. Johnson Space Center. *Apollo 14: Preliminary Science Report*. Washington, DC: NASA SP-272, 1971. A straight-forward description of the scientific analysis of data collected during the January-February 1971 Apollo 14 mission to Fra Mauro.

- Lyndon B. Johnson Space Center. *Apollo 17: Preliminary Science Report*. Washington, DC: NASA SP-330, 1973. This lengthy, 650-page, study presents analysis of data collected during the last and most scientifically involved mission of Project Apollo.
- Lyndon B. Johnson Space Center. *Apollo-Soyuz Test Project: Summary Science Report*. Washington, DC: NASA SP-412, 1977-79. This two-volume report discusses the entire range of scientific experiments and results from the 1975 international mission with the Soviet Union.
- McCall, G.J.H. "The Lunar Controversy." *Journal of the British Astronomical Association*. 80 (1969): 19-29, 100-06, 190-99, 263-69, 358-60. A very fine run-down of the state of the debate over lunar origins and evolution taking place between several influential scientists and their supporters.
- Manned Spacecraft Center. *Apollo 12 Preliminary Science Report*. Washington, DC: NASA SP-235, 1970. Issued within months of the second lunar mission, this 227-page report gleans some of the major findings from the scientific instruments used and experiments conducted in December 1969.
- Manned Spacecraft Center. *Apollo 15: Preliminary Science Report*. Washington, DC: NASA SP-289, 1972. Issued within months of the Apollo 15 mission to Hadley Rille and the Apennine Mountains, this report discusses, among other things, the so-called "Genesis Rock," a sample of ancient lunar crust of wide geological interest.
- Manned Spacecraft Center. *Apollo 16: Preliminary Science Report*. Washington, DC: NASA SP-315, 1972. This study traces the major investigations of Apollo 16 astronauts in the Descartes highland region of the Moon in April 1971.
- Marvin, Ursula B. "Meteorites, the Moon and the History of Geology." *Journal of Geological Education* 34 (May 1986): 140-65. A very good introduction to the study of Earth-impacting meteorites and how these relate to the cratering on the Moon, as well as a discussion of the origins of the Moon and its overall evolution.
- Mason, Brian H. "The Lunar Rocks." *Scientific American*. 225 (October 1971): 48-58. This is an analysis of the lunar samples returned during Project Apollo, written for the informed non-scientist. It is a condensation of many of the findings discussed at length in the book Mason wrote with William G. Melson.
- \_\_\_\_\_. and Melson, William G. *The Lunar Rocks*. New York: Wiley Interscience, 1970. This book is a scientific assessment of the data gained from analysis of the lunar samples returned by Apollo 11.
- McLane, James C., Jr. "Collecting and Processing Samples of the Moon." *Astronautics & Aeronautics*. 5 (August 1967): 34-46. Describes the Lunar Receiving Lab and describes how samples will be maintained.
- Minnaert, M. "Photometry of the Moon." In *Planets and Satellites*. Kuiper, Gerard P., and Middlehurst, Barbara M. Editors. *The Solar System*, Vol. 3. Chicago: University of Chicago Press, 1961. Pp. 213-48. A solid discussion of the scientific returns from early satellite and Earth-based study of the lunar surface.
- Mitchell Edgar D. *Psychic Exploration: A Challenge for Science*. New York: G.P. Putnam's Sons, 1974. Edited by John White. Written by an Apollo astronaut, this book describes, in addition to other astronaut anecdotes, the attempts to link minds through ESP during the Apollo 14 mission. This was not a formally-recognized NASA experiment.
- Mitroff, Ian I. *The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists*. New York: American Elsevier Pub. Co., 1974. Also published in Amsterdam. Reprinted Seaside, CA: Intersystems Publications, 1983. This important study raises questions about the nature of

science and its ability to provide non-biased, objective answers to questions. Using the Apollo program scientists as an example, the author demonstrates the subjective nature of questions asked of scientific data and the answers that are based on incomplete data that could be interpreted in a variety of ways.

Moore, H.J., et al. *Lunar Remote Sensing and Measurements*. Reston, VA: U.S. Dept. of the Interior, Geological Survey, 1980. This Apollo monograph presents data from Apollo 15-17 orbital investigations.

Muehlberger, W.R., et al. *Documentation and Environment of the Apollo 16 Samples: A Preliminary Report*. Washington, DC: Apollo Lunar Geology Investigation Team, U.S. Geological Survey, 1972. This study traces the major investigations of Apollo 16 astronauts in the Descartes highland region of the Moon. Based on their geologic investigations, scientists found that a region previously thought to be volcanic turned out not to be.

\_\_\_\_\_, et al. *Preliminary Report on the Geology and Field Petrology at the Apollo 17 Landing Site*. Washington, DC: U.S. Department of Interior, Geological Survey, 1972. This study presents analysis of data collected during the last and most scientifically involved mission of Project Apollo.

\_\_\_\_\_, et al. *Documentation and Environment of the Apollo 17 Samples: A Preliminary Report*. Washington, DC: Apollo Lunar Geology Investigation Team, U.S. Geological Survey, 1973. Like the preceding work, this study presents analysis of data collected during the last and most scientifically involved mission of Project Apollo.

Mulholland, J. Derral. "The Impact of Lunar Laser Ranging on Gravitational Theory." *Astronomy Quarterly*. 6 (1989): 17-26. This study is important in showing the interrelationships of NASA and the scholarly community and how they used laser-ranging to developing important theories about lunar gravitation.

Murray, Bruce; Malin, Michael C.; and Greeley, Ronald. *Earthlike Planets: Surfaces of Mercury, Venus, Earth, Moon, Mars*. San Francisco: W.H. Freeman, 1981. A basic science text on this subject using the latest findings.

Mutch, Thomas A. *Geology of the Moon: A Stratigraphic View*. Princeton, NJ: Princeton University Press, 1970. Provides an analysis of the Moon's age and origin, shape and motion, volcanic activity and meteor bombardment as far as knowledge was available at the time of publication. Designed for college-level use, it employs the data returned from Project's Ranger, Surveyor, and Lunar Orbiter, as well as Apollo in analyzing the features of the Moon.

NASA Editorial Review Board, R. Thomas Giuli (Chair). *Apollo-Soyuz Test Project: Preliminary Science Report*. Washington, DC: National Aeronautics and Space Administration, 1976. NASA Technical Memorandum-X-58173. In 529 pages, this loose-leaf report discusses the entire range of scientific experiments and results that were undertaken during the 1975 international mission with the Soviet Union.

National Academy of Sciences, Space Science Board. *Lunar Exploration: Strategy for Research, 1969-1975, Report of a Study by the Space Science Board*. Washington, DC: National Academy of Sciences, 1969. This study represents an attempt to answer the question, "how best to utilize the manned lunar-landing capability [achieved by Apollo 11] to realize the scientific objectives of lunar exploration." Broadly, the board recommended "a shift of emphasis from technological development to exploitation of existing Apollo technology for scientific objectives." Divided into chapters on "Lunar Age Measurements," "Geochemistry and Petrology," "Geophysics," "Geology and Geomorphology," and "Lunar-Science Management," this short report provides a basis of comparison with the lunar research actually done on the ensuing Apollo missions to see the extent to which its recommendations were carried out.

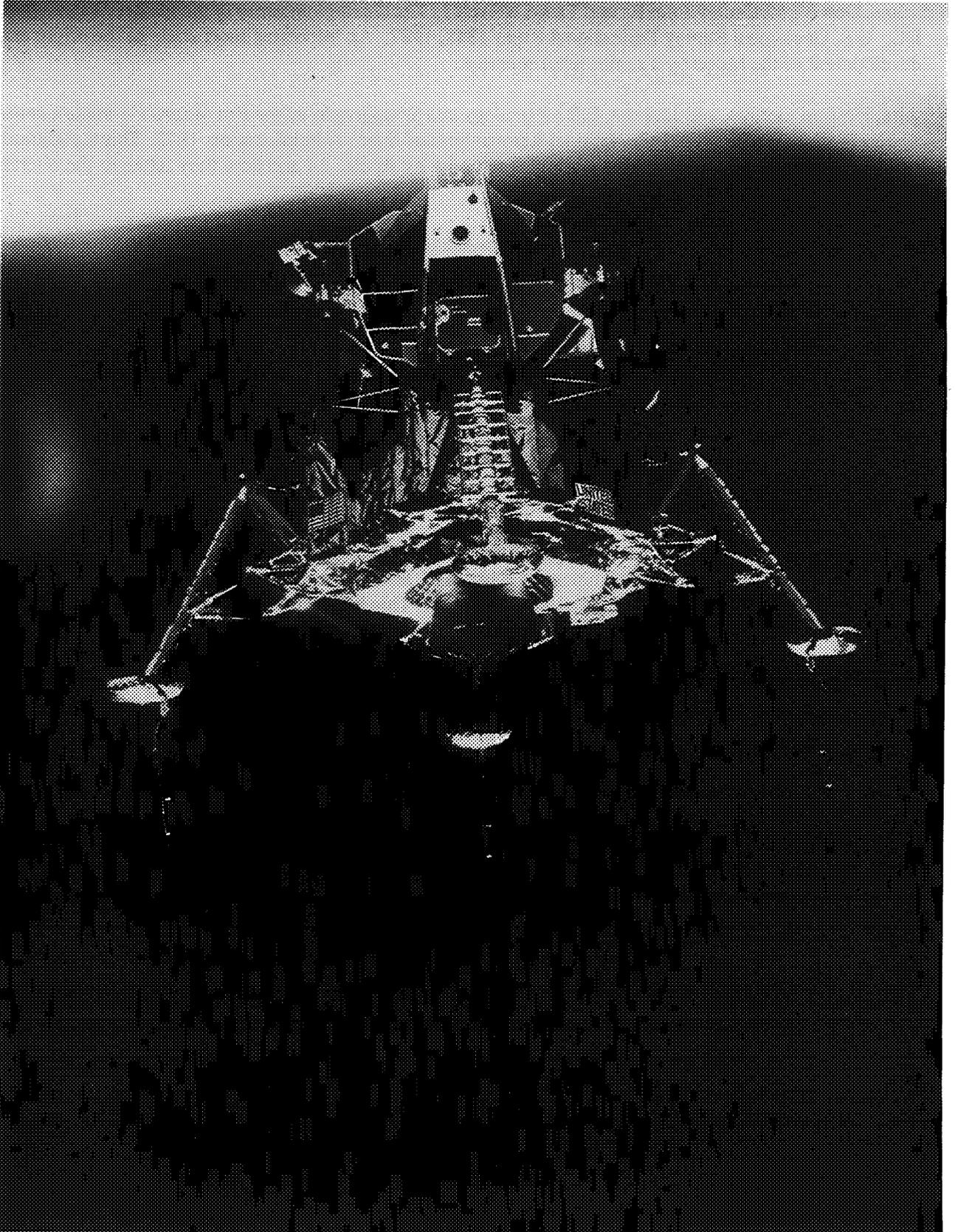
- Naugle, John E. *First Among Equals: The Selection of NASA Space Science Experiments*. Washington, DC: NASA SP-4215, 1991. This is an important monograph that traces the origin and evolution of the agency's methods of selecting scientific experiments for flight. Naugle, a former NASA chief scientist, finds this activity's source in the period immediately following World War II as scientists began using captured V-2 rockets to conduct research beyond the atmosphere. Although the selection process was taking shape before NASA was formed in 1958, it evolved rapidly during the agency's formative years. By 1962 its essentials as a NASA policy had been established, and the agency has followed the general selection process since that time.
- Nehru, C.E.; Warner, Richard D.; and Keil, Klaus. *Electron Microprobe Analyses of Opaque Mineral Phases from Apollo 11 Basalts*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1976. This monograph describes the analysis of certain lunar samples taken from specific sites during the Apollo 11 mission of July 1969.
- Newell, Homer E. *Beyond the Atmosphere: Early Years of Space Science*. Washington, DC: NASA SP-4211, 1980. Part memoir and part research project, *Beyond the Atmosphere* is an important study of the development of space science in NASA during the first fifteen years of the agency's existence. Written by the head of the space science program within the agency until 1973, this book presents an especially candid portrait of the trials and successes of scientific endeavor within NASA.
- Nicks, Oran W. *Far Travelers: The Exploring Machines*. Washington, DC: NASA SP-480, 1985. A memoir by one of the leaders of NASA's scientific program, this book traces the development and employment of satellite probes launched by the agency. There are important discussions of Project Ranger and several other lunar probes. The emphasis is on equipment, data collection and dissemination, and internal struggles for say in the direction of programs and projects.
- Nicogossian, Arnauld E. Compiler. *The Apollo-Soyuz Test Project Medical Report*. Washington, DC: NASA SP-411, 1977. A major discussion of the biomedical results of this important joint mission with the U.S. and the U.S.S.R.
- O'Hara, M.J. "Lunar Geology in the Light of the Apollo Programme." *Endeavour*. 30 (January 1971): 3-7. A general discussion of the major contributions of Apollo to the study of lunar geology.
- Page, Lou Williams, and Page, Thornton. *Apollo-Soyuz [experiments in space]*. Washington, DC: NASA EPs-133 through 141, 1977. Pamphlet no. 1. The flight.—Pamphlet no. 2. X-rays, gamma-rays.—Pamphlet no. 3. Sun, Stars, In between.—Pamphlet no. 4. Gravitational Field.—Pamphlet no. 5. The Earth from Orbit.—Pamphlet no. 6. Cosmic Ray Dosage.—Pamphlet no. 7. Biology in Zero-G.—Pamphlet no. 8. Zero-G Technology.—Pamphlet no. 9. General Science. These nine pamphlets are based on investigators' reports of experimental results, written with the help of advising teachers to serve as "curriculum supplements designed for teachers, supervisors, curriculum specialists, and textbook writers as well as for the general public." Dr. Lou Williams Page, a geologist, and Dr. Thornton Page, an astronomer, brought their special expertise to the writing.
- Page, T.L. "The Third Lunar Science Conference-I." *Sky and Telescope*. 43 (March 1972): 145-50. A general discussion of the presentations made at this important scientific gathering.
- Page, T.L. "The Third Lunar Science Conference-II." *Sky and Telescope*. 43 (April 1972): 219-22. A general discussion of the presentations made at this important scientific gathering.
- Pitts, John A. *The Human Factor: Biomedicine in the Manned Space Program to 1980*. Washington, DC: NASA SP-4213, 1985. This necessarily rather technical account traces the history of space medicine from

- its early days before the founding of NASA through the decade following the Apollo program. It covers the beginnings of NASA's small life sciences program during Project Mercury, the struggles between NASA and the Air Force for funding of life science research, biomedicine during the Gemini and Apollo programs, the crisis that followed the Apollo 204 fire in January 1967, the biomedical results from Apollo, and the various reorganizations of the life sciences program in NASA that accompanied its evolution. It concludes with a look ahead to the Shuttle era that began in the 1980s.
- Prinz, Martin, et al. *Electron Microprobe Analyses of Lithic Fragments, Glasses, Chondrules, and Minerals in Apollo 14 Lunar Samples*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1973. This monograph describes the lunar samples taken from specific sites during the January-February 1971 flight of Apollo 14 to Fra Mauro on the Moon.
- Rabinowitch, Eugene I., and Lewis, Richard S. Editors. "Man on the Moon: An Assessment." Special Issue. *Bulletin of the Atomic Scientists*. 25 (September 1969). This special issue of this prestigious journal was dedicated to Project Apollo. Many of the essays focus on scientific aspects of the mission.
- Ringwood, A.E. "Petrogenesis of Apollo 11 Basalts and Implications for Lunar Origin." *Journal of Geophysical Research*. 75 (10 November 1970): 6453-79. This scientific paper presents data from the first lunar landing in the Sea of Tranquility and relates it to the debate over lunar origins. The evidence is inconclusive.
- Ryder, Graham. *Catalog of Apollo 15 Rocks*. Houston, TX: Lyndon B. Johnson Space Center, 1985. A straightforward description of the samples collected during the Apollo 15 mission to Hadley Rille and the Apennine Mountains where Apollo 15 conducted its mission. During this mission the astronauts discovered what has been called the "Genesis Rock," a sample of ancient lunar crust of wide geological interest.
- Sagan, Carl. "Harold Clayton Urey—In Memoriam." Obituary. *Icarus*. 48 (1981): 348-52. This is an interesting piece about one of the key scientists concerned with lunar origins, written by a leading public intellectual who knew him well and remembered him fondly.
- Salisbury, John W., et al. Editors. *Bibliography of Lunar and Planetary Research, 1961*. Bedford, MA: Air Force Cambridge Research Laboratories, Office of Aerospace Research, U.S. Air Force, 1962. A bibliography of scientific papers and books on the subject for one of the pivotal years in lunar science.
- Simmons, Gene. *On the Moon with Apollo 16: A Guidebook to the Descartes Region*. Washington, DC: National Aeronautics and Space Administration, 1972. This 90-page study traces for a non-scientific audience the major investigations of Apollo 16 astronauts in the Descartes highland region of the Moon. Based on their geologic investigations, scientists found that a region previously thought to be volcanic turned out not to be.
- Simmons, Gene. *On the Moon with Apollo 17: A Guidebook to Taurus-Littrow*. Washington, DC: National Aeronautics and Space Administration, 1972. This 111-page study for non-scientists presents analysis of data collected during the last and most scientifically involved mission of Project Apollo.
- Sinton, William M. "Recent Radiometric Studies of the Planets and the Moon." In *Planets and Satellites*. Kuiper, Gerard P., and Middlehurst, Barbara M. Editors. *The Solar System*, Vol. 3. Chicago: University of Chicago Press, 1961. Pp. 429-41. An excellent overview of the early satellite investigations of the Moon conducted in 1959 and 1960.
- Sjogren, W.L., et al. "Lunar Gravity via Apollo 14 Doppler Radio Tracking." *Science*. 175 (14 January 1972): 165-68. An analysis of the data obtained by doppler on the Apollo spacecraft concerning lunar gravity, confirming earlier estimates of 1/6 of Earth's gravity.

- Smith, G. M.; Vrebalovich, J.; and Willingham, O. E. "Eyes on the Moon." *Astronautics & Aeronautics*. 4 (March 1966): 74-83. A Discussion of Ranger photos and how they put to rest some old theories and stimulated new ones.
- Smith, M.C., Jr., et al. "Apollo 14 Food System." *Aerospace Medicine*. 42 (November 1971): 1185-92. A description of the hardware, food processing, and management procedures in place for food used on the Apollo 14 flight to the Moon.
- Sutton, R.L., et al. *Documentation of Apollo 17 Samples*. Washington, DC: Apollo Lunar Geology Investigation Team, U.S. Geological Survey, 1972. A basic catalog of the lunar rock and soil samples returned on the flight of Apollo 17 in 1972.
- Swann, G.A. *Preliminary Description of Apollo 15 Sample Environments*. Washington, DC: U.S. Geological Survey, 1971. A scientific discussion of the locations from which samples were returned from the Hadley Rille and Apennine Mountain areas where Apollo 15 conducted its mission.
- Sykes, Egerton. *The Moon Capture Theory of Hoerbiger After Fifty Five Years*. London: Markham House, 1966. An important analysis of the rise, alteration, and fall of the theory of lunar origins that emphasized the gravitational capture of the Moon (then a wandering planetesimal) by the Earth.
- Tatarewicz, Joseph N. *Space Technology and Planetary Astronomy*. Bloomington: Indiana University Press, 1990. Much broader than lunar science, this important book analyzes the development of space science as a discipline in the period since the birth of NASA by noting the interrelationships of the scientific community with the space agency.
- Taylor, Stuart Ross. *Lunar Science: A Post-Apollo View; Scientific Results and Insights from the Lunar Samples*. New York: Pergamon Press, 1975. An excellent book describing the scientific results from Project Apollo written for the Earth and space scientist.
- \_\_\_\_\_. *Planetary Science: A Lunar Perspective*. Houston, TX: Lunar and Planetary Institute, 1982. Using the information gleaned from a lifetime of lunar science, this senior scientist describes the origin and development of the Solar System.
- Tift, William G. "Astronomy, Space, and the Moon." *Astronautics & Aeronautics*. 4 (September 1966): 40-52. Many factors were involved in the selection of sites for lunar landings and astronomical observations. This essay outlines these factors and makes some suggestions.
- Toksoz, N.M., et al. "Lunar Crust: Structure and Composition." *Science*. 176 (2 June 1972): 1012-16. An excellent analysis of the lunar surface based on the latest data returned by the Apollo spacecraft, written so that it is understandable to a non-specialist.
- Ulrich, George E.; Hodges, Carroll Ann; and Muehlberger, William R. Editors. *Geology of the Apollo 16 Area, Central Lunar Highlands*. Reston, VA: U.S. Dept. of the Interior, Geological Survey, 1981. Geological Survey professional paper no. 1048. This 539-page study traces the major geological investigations of Apollo 16 astronauts in the Descartes highland region of the Moon. Based on their geologic investigations, scientists found that a region previously thought to be volcanic turned out not to be.
- Urey, Harold C. *The Planets: Their Origin and Development*. New Haven: Yale University Press, 1952. A classic discussion of the origins of the Solar System, the author—one of the deans of planetary science—argued that the bodies of the system had condensed from a dust cloud that contained water vapor. It had been a cold condensation where low density material condensed first and higher density material like iron later. This cold origin thesis has been a central part of the debate over Solar System formation.

- . "The Origin and Significance of the Moon's Surface." *Vistas in Astronomy*. 2 (1956): 1667-80. In this article Urey espoused the idea that the Moon had been captured by the Earth and has preserved information about the earliest history of the Solar System, which led him to advocate a manned lunar landing program.
- U.S. Geological Survey. *Apollo 17 Landing Site Geology*. Houston, TX: Lyndon B. Johnson Space Center, 1975. A discussion of the geology of the Apollo 17 site based on the lunar samples and written for a scientific audience.
- Warner, Jeffrey. *Apollo 12 Lunar-Sample Information*. Washington, DC: National Aeronautics and Space Administration, 1970. General description of the returns of lunar rock and soil during Apollo 12.
- Warner, Richard D., et al. *Catalogue of Apollo 16 Rake Samples from the LM Area and Station 5*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1976. This study traces the major findings from the raked samples of lunar soil recovered during Apollo 16.
- Warner, Richard D., et al. *Electron Microprobe Analyses of Glasses from Apollo 17 Rake Sample Breccias and Apollo 17 Drill Core*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1979. A scientific discussion of use to other lunar scientists.
- Warner, Richard D., et al. *Electron Microprobe Analyses of Olivine, Pyroxene, and Plagioclase from Apollo 17 Rake Sample Mare Basalts*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1976. A scientific discussion of use to other lunar scientists.
- Warner, Richard D., et al. *Electron Microprobe Analyses of Spinel, Fe-Ti Oxides, and Metal from Apollo 17 Rake Sample Mare Basalts*. Albuquerque, NM: Dept. of Geology & Institute of Meteoritics, University of New Mexico, 1976. A scientific discussion of use to other lunar scientists.
- Wasserburg, G. J. "The Moon and Sixpence of Science." *Astronautics & Aeronautics*. 10 (April 1972): 16-21. An assessment of lunar science as revised by Apollo.
- Whitaker, Ewen A. *The University of Arizona's Lunar and Planetary Laboratory, Its Founding and Early Years*. Tucson, AZ: Lunar and Planetary Laboratory, 1985. One of the centers of lunar science was the University of Arizona, because of several key scientists located there and their access to excellent observatories. This book describes the development of the institution where they worked, along with describing their theories, controversies, and relations with NASA.
- White, David R. *Apollo Experience Report—Lunar-Sample Processing in the Lunar Receiving Laboratory, High-Vacuum Complex*. Houston, TX: Lyndon B. Johnson Space Center, 1976. NASA technical note D-8298. A short report on a complex topic.
- Wilhelms, Don E. *Stratigraphy of Part of the Lunar Near Side*. Washington, DC: National Aeronautics and Space Administration, 1980. A comprehensive survey of findings from Apollo landings.
- Wilhelms, Don E. *To a Rocky Moon: A Geologist's History of Lunar Exploration*. Tucson: University of Arizona Press, 1993. This lengthy and detailed account of lunar exploration and science strikes a balance between personal memoir and history. As history it provides a detailed and contextual account of lunar geology during the 1960s and 1970s, and a less-detailed but informative account for the rest of the century. As memoir it provides an engaging story of the scientific exploration of the Moon as seen by one of the field's more important behind-the-scenes scientists.

- Wilhelms, Don E.; McCauley John F.; and Trask, Newell J. *The Geologic History of the Moon*. Washington, DC: U.S. Geological Survey Professional Paper 1348, 1987. An important short study of the origin and development of the Moon by a senior lunar scientist.
- Wilshire, Howard Gordon, and Jackson, E.D. *Petrology and Stratigraphy of the Fra Mauro Formation at the Apollo 14 Site*. Washington, DC: National Aeronautics and Space Administration, 1972. This monograph presents a scientific discussion of the samples returned by Apollo 14 and how they relate to the overall geologic development of the region.
- Winter, Thomas C., Jr. "Apollo Solar Experiments—Paving the Way for Advanced Solar Observation." *Astronautics & Aeronautics*. 7 (March 1969): 64-71. A useful overview of the scientific experiments in solar science arising from Project Apollo.
- Wolfe, Edward W., et al. *The Geological Investigation of the Taurus-Littrow Valley, Apollo 17 Landing Site*. Reston, VA: U.S. Dept. of the Interior, Geological Survey, 1981. With a section on Apollo 17 lunar surface photography by Raymond M. Batson, Kathleen B. Larson, and Richard L. Tyner. Geological Survey professional paper no. 1080 containing a "synthesis of Apollo 17 lunar surface data and sample results."
- Wood, John Edwin. *Sun, Moon, and Sanding Stones*. New York: Oxford University Press, 1978. A useful survey of origins and evolution.
- Wright, Frederick E.; Wright, F.H.; and Wright, Helen. "The Lunar Surface: Introduction." In *The Moon, Meteorites, and Comets*. Gerard P. Kuiper and Barbara M. Middlehurst. Editors. *The Solar System, Vol. 4*. Chicago: University of Chicago Press, 1963. Pp. 1-56. This important overview describes the various theories of lunar origin and evolution then being debated in academic circles.
- Wright, Hamilton; Wright, Helen; and Rapport, Samuel. Editors. *To the Moon: A Distillation of the Great Writings from Ancient Legend to Space Exploration*. New York: Meredith, 1968. A useful anthology of writing from the ancients to the present about the Moon. The essays are both scientific and cultural in orientation.



*Another photo of the lunar module during Apollo 11. NASA photo 69-H-1379.*

## CHAPTER 8

# ASTRONAUTS

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Aldrin, Edwin E. "Buzz," and McConnell, Malcolm. *Men from Earth*. New York: Bantam Books, 1989. This useful recent memoir and history by one of the first two humans on the Moon and his co-author, who himself wrote a book on the Challenger disaster, discusses the Moon race, Aldrin's flight during Gemini as well as the one to the Moon, and subsequent space efforts by NASA and the Soviets.

Aldrin, Edwin E. "Buzz" with Wayne Warga. *Return to Earth*. New York: Random House, 1973. As the title would suggest, this book is more autobiography than account of the trip to the Moon on Apollo 11. It discusses Aldrin's bouts with alcoholism and depression following his famous voyage to a greater extent than it covers the Moon landing and his experiences in NASA. Not as well written as his later book, this one nevertheless reveals a good bit about the character of one astronaut and the perplexities that he and others faced as they became famous public figures.

"*All we did was Fly to the Moon*". By the Astronauts as told to Dick Lattimer. Foreword by James A. Michener. Alachua, FL: Whispering Eagle Press, 1983. This little picture book contains photos of astronauts, insignia, and the like plus comments by astronauts. Covers Mercury through Apollo-Soyuz.

"Apollo 8, Astronauts Report on Their Flight Around the Moon." *Interavia*. 24 (February 1969): 186-90. An abridged version of a press conference the Apollo 8 astronauts held on 9 January 1969. Includes photos and diagrams to illustrate the mission.

Armstrong, Neil; Collins, Michael; and Aldrin, Edwin E. Jr. *First on the Moon: A Voyage with Neil Armstrong, Michael Collins and Edwin E. Aldrin, Jr.* Written with Gene Farmer and Dora Jane Hamblin. Epilogue by Arthur C. Clarke. Boston: Little, Brown, 1970. This is the "official" memoir of the Apollo 11 landing mission to the Moon in 1969. It was prepared by the ghost writers Farmer and Hamblin from information made available exclusively to them through a somewhat infamous Time-Life/Field Enterprises contract that excluded the rest of the media from contact with the astronauts' families. Contains much personal information about the astronauts that is not available elsewhere.

"The Astronauts—Their Own Great Stories." *Life*. 22 August 1969, pp. 22-29. 6 color, 3 B&W photos. The first personal accounts of the Apollo 11 lunar landing as told by the astronauts. Also, "The New Priorities in Exploring Space," p. 30, cartoon. An editorial about what the next steps in space should be. Also, "Were You an Eyewitness?" p. 49.

Atkinson, Joseph D., Jr., and Shafritz, Jay M. *The Real Stuff: A History of the NASA Astronaut Requirement Program*. New York: Praeger Pubs., 1985. The authors present a solid overview of the selection of the NASA astronauts and their development. It presents an overview of the selection of the first ten groups of NASA astronauts through 1984, then concentrates on covering the watershed selections of 1959, the first group; 1965, the first scientists that flew on Apollo spacecraft; and 1978, the first Shuttle selection including women and minorities. Places heavy emphasis on the criteria for selection and the procedures used in selected astronauts.

Borman, Frank. *Countdown: An Autobiography*. New York: William Morrow, Silver Arrow Books, 1988. With Robert J. Serling. Written to appear on the twentieth anniversary of the first lunar landing, this autobiography spans much more than the Apollo program. It recounts Borman's life in aeronautics, first as a military flier, then as a test pilot, and finally as president of Eastern Airlines.

- Collins, Michael. *Carrying the Fire: An Astronaut's Journeys*. New York: Farrar, Straus and Giroux, 1974. This is the first candid book about life as an astronaut, written by the member of the Apollo 11 crew that remained in orbit around the Moon. The author comments on other astronauts, describes the seemingly endless preparations for flights to the Moon, and assesses the results. He also describes what he thinks of as the most important perspective that emerged from his flight, a realization of the fragility of the Earth. He wrote that "from space there is no hint of ruggedness to it; smooth as a billiard ball, it seems delicately poised on its circular journey around the Sun, and above all it seems fragile.... Is the sea water clean enough to pour over your head, or is there a glaze of oil on its surface?... Is the riverbank a delight or an obscenity? The difference between a blue-and-white planet and a black-and-brown one is delicate indeed."
- Cooper, Henry S.F. *Apollo on the Moon*. New York: Dial Press, 1969. In this book Cooper predicts, before the landing of Apollo 11 astronauts on the Moon in July 1969, what they would encounter. More important, he follows the preparations for the mission with great skill and recounts them in his personal and scintillating style. A small work, this book is barely 140 pages and is taken almost verbatim from two of Cooper's *New Yorker* articles.
- Cox, Donald W. *America's Explorers of Space: Including a Special Report on Project Apollo*. Maplewood, NJ: Hammond, 1969. This collection of popular biographical sketches of astronauts and such other "explorers of space" as Wernher von Braun and William H. Pickering also contains an overview of Project Apollo.
- Cunningham, Walter, with Herskowitz, Mickey. *The All-American Boys*. New York: Macmillan Co., 1977. This candid memoir by a former Marine jet jockey with a Ph.D. in physics who became a civilian astronaut is critical of "the myth of the super-hero astronaut." Aided by Texas newsman Herskowitz, Cunningham says the astronauts were "all too human" in both their strengths and their weaknesses. Cunningham relates his flight on Apollo 7, which followed the Apollo 204 fire and became the first successful Earth-orbiting mission. He also provides valuable insights into "astropolitics," the way the astronaut corps functioned.
- El-Baz, Farouk. *Astronaut Observations from the Apollo-Soyuz Mission*. Washington, DC: Smithsonian Institution Press, 1977. This volume consists partly of text, partly of extensive photographs and maps of the Earth taken by astronauts on their training flights for the mission or taken on board the spacecraft to support the Earth Observations and Photography Experiment conducted during the mission. Another portion of the text consists of verbal comments made by American astronauts regarding that experiment. The remaining 122 pages of text consists of discussions of the scientific objectives of the mission, astronaut training, flight planning, mission operations, and a summary of the scientific findings of the mission in the areas of geology, oceanography, hydrology, meteorology, and environmental science.
- Farmer, G., and Hamblin, D. *First on the Moon*. Boston: Little, Brown, 1970. See under Armstrong, Neil.
- "For the Heroes, Salute and Farewell." *Life*. 10 February 1967, pp. cover, 20-31. 20 color photos depict the funerals of the Apollo 204 astronauts; also, 3 B&W photos of the burned capsule and interior.
- Frank, Joseph. *The Doomed Astronaut*. New York: Winthrop Publishers, 1972. This book documents that flying has been a human obsession since antiquity, and that commentary on it has been notoriously pessimistic. Then the author argues that continued flights in space by astronauts are doomed to failure. He uses mythological figures, especially Icarus, to make this case repeatedly in the book, and uses transcripts from Walter Cronkite's broadcasts of the Apollo 13 near-disaster as modern evidence of his position.
- Goldstein, Stanley H. *Reaching for the Stars: The Story of Astronaut Training and the Lunar Landing*. New York: Praeger, 1987. This is a detailed account of the development and management of the astronaut training program for Project Apollo.

Grissom, Betty, and Still, Henry. *Starfall*. New York: Thomas Y. Crowell, 1974. This account co-authored by the wife of Astronaut Vergil I. "Gus" Grissom with a veteran journalist and aerospace executive recounts the astronaut's career and tragic death in the Apollo 204 fire. The book naturally devotes a good deal of attention to the fire. Betty's lawsuit against North American Aviation, builder of the command and service module in which the fire occurred, for the damage to her and her children also forms part of the story, resulting in her out-of-court settlement for \$350,000.

Irwin, James B[enson], with Emerson, William A., Jr. *To Rule the Night: The Discovery Voyage of Astronaut Jim Irwin*. Boston: G.K. Hall, 1974. Philadelphia: J.B. Lippincott Co., 1973. This readable autobiography of an Air Force pilot turned astronaut recounts his astronaut training and trip to the Moon on Apollo 15 together with his other experiences in life to that point. Stronger on impressions than details, this book nevertheless provides his personal perspective on flying in space.

Kozloski, Lillian D. *U.S. Space Gear: Outfitting the Astronaut*. Washington, DC: Smithsonian Institution Press, 1994. This extensively illustrated, large-format book follows the history of space suits from flying suits and the development of the pressure suit through Mercury, Gemini, Apollo, Skylab and Apollo-Soyuz, through the shuttle era, concluding with a chapter entitled "Space Suits in the National Collection." There are 11 appendices, a glossary, reference notes, a select bibliography, and an index. Much more than a coffee-table decoration, this is a valuable reference source.

Lovell, James A., et al. "The Three Astronauts Tell What Happened Aboard the Crippled Apollo 13." *Life*, 68 (1 May 1970): 24-33. An account in the astronauts' own words of what happened on Apollo 13, accompanied by the usual number of photos.

MacKinnon, Douglas, and Baldanza, Joseph. *Footprints: The 12 Men Who Walked on the Moon Reflect on their Flights, their Lives and the Future*. Washington, DC: Acropolis Books, 1989. An illustrated history, this book tells in narrative and photographs the story of Project Apollo. It emphasizes the stories of the astronauts, printing twelve interviews with those who walked on the Moon. Unfortunately, the book fails on several levels. The authors make no attempt to tie the interviews together, and the astronauts provide no revealing insights. The lode of astronaut impressions was exhausted long before this book was compiled.

Mailer, Norman. "The Psychology of Astronauts." *Life*. 14 November 1969, pp. 50-60, 62-63. 1 color, 1 B&W photo. Part II of Norman Mailer's "A Fire on the Moon" examines pre-flight training and astronaut philosophies. Also, "Saturn 5," p. 9. Color ad by Monogram models showing a Saturn 5 and U.S. Space Missile models.

"The Moon Men Now." *Life*. July 1979, pp. 76-84. 15 color and B&W photos. A good article on what many of the Apollo astronauts were doing ten years after the first Moon landing.

"The Old Pro Gets His Shot at the Moon." *Life*. 31 July 1970, pp. 48-56. 2 color, 5 B&W photos. A biography of Alan B. Shepard who was to be commander of the Apollo 14 mission—his life since his first flight in 1961.

"The Old Pro Goes All the Way." *Life*. 19 February 1971, pp. 32-35. 2 color, 4 B&W photos on the flight of Apollo 14. Highlights Alan Shepard.

O'Leary, Brian. *The Making of an Ex-Astronaut*. Boston: Houghton Mifflin Company, 1970. This is an acidic look at the astronaut selection process inside NASA, as well as a bitter memoir of the politics of flight assignments.

...*On Course to the Stars: The Roger B. Chaffee Story*. Grand Rapids, MI: Kregel Publications, 1968. As told to C. Donald Chrysler by Don L. Chaffee and Family. A very moving personal account of the life of Astronaut Roger Chaffee and his death in the Apollo 204 fire.

"Our Journey to the Moon." *Life*. 17 January 1969, pp. 26-31. 4 photos, 3 in color. Personal accounts by the three Apollo 8 astronauts.

"Put Them High on the List of Men Who Count." *Life*. 3 February 1967, pp. cover, 18-27. 15 B&W photo essay on astronauts Grissom, White, and Chaffee killed in the Apollo 204 fire.

Schirra, Walter M., Jr. *Schirra's Space*. Boston: Quinlan Press, 1988. With Richard N. Billings. Another astronaut memoir, this one is filled with practical jokes and anecdotes about mundane training. It also offers some revealing new details of the spaceflights, particularly the shakedown flight of Apollo 7 in Earth orbit in October 1968.

"Schirra's Team Carries on for Apollo." *Life*. 19 May 1967, pp. cover, 32-39. 21 color photos mainly of astronauts Schirra, Eisele, and Cunningham relaxing with their families.

Wilson, Andrew, and Shayler, David J. "Return to Apollo." *Spaceflight*. 22 (January 1980): 7-21. This article provides a retrospective look at the astronauts who flew on the Apollo lunar missions.

# CHAPTER 9

## MANAGEMENT

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- Biddle, Wayne. "Two Faces of Catastrophe." *Air and Space/Smithsonian*. 5 (August/September 1990): 46-49. Discusses the different ways in which NASA handled the Apollo 204 fire in 1967 and the Challenger disaster in 1986. Biddle concludes that the comparison shows NASA had become more fragile and lost direction following the Moon landing.
- Bilstein, Roger E. *Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles*. Washington, DC: National Aeronautics and Space Administration SP-4206, 1980. This thorough and well-written book gives a detailed but highly readable account of the enormously complex process whereby the Marshall Space Flight Center under the direction of Wernher von Braun developed the launch vehicles used in the Apollo program ultimately to send twelve humans to the Moon. Based on exhaustive research and equipped with extensive bibliographic references, this book comes as close to being a definitive history of the Saturn rocket program as is ever likely to appear. Moreover, it is not simply a technical history but covers the decision-making process that lay behind the technological development, making it not just a history of hardware development but also an analysis of technical management and organization. As one reviewer said in *Air University Review*, "This volume is just one of many excellent histories produced by government and contract historians for the NASA History Office....The book is enhanced by many excellent appendixes and charts, and it has a thorough essay on sources and documentation....Author Roger Bilstein...gracefully wends his way through a maze of technical documentation to reveal the important themes of his story; rarely has such a nuts-and-bolts tale been so gracefully told."
- Chapman, Richard L. *Project Management in NASA: The System and the Men*. Washington, DC: NASA SP-324, 1973. Based on almost 150 interviews and contributions by NASA officials, this slight and somewhat uncritical study does provide a useful look at NASA's project management system that contributed significantly to the success of the Apollo program. Although far from a definitive treatment, this volume provides useful information on management within NASA during the Apollo era, even though it does not focus specifically on Apollo. It covers especially the Office of Space Science and Applications, the Office of Advanced Research and Technology, and field center organization. Equipped with useful if dated and selected reference notes and bibliography.
- Goldstein, Stanley H. *Reaching for the Stars: The Story of Astronaut Training and the Lunar Landing*. New York: Praeger, 1987. This is a detailed account of the development and management of the astronaut training program.
- Houbold, John C. "Lunar Rendezvous." *International Science and Technology*. 14 (February 1963): 62-65. Discusses the author's role in the development and promotion of lunar rendezvous, the method ultimately chosen for reaching the Moon in the Apollo program.
- Kraft, Christopher C., et al. "Flexible Yet Disciplined Mission Planning." *Astronautics and Aeronautics*. 8 (March 1970): 84-88. Four managers at the Manned Spacecraft Center discuss the evolution of mission planning for Apollo since the inception of the program. They stress the need for flexibility in the development program and the capacity to react to major readjustments in the program.
- Lambright, W. Henry. "James E. Webb: A Dominant Force in 20th Century Public Administration." *Public Administration Review*. 53 (March/April 1993): 95-99. This discussion of the life and management

practices of the NASA administrator during the bulk of the Apollo period provides an important perspective on the ways NASA reached President Kennedy's goals for Apollo.

- \_\_\_\_\_. "James Webb and the Uses of Administrative Power." In Doig, James W. and Hargrove, Erwin C. Editors. *Leadership and Innovation: A Biographical Perspective on Entrepreneurs in Government*. Baltimore: The Johns Hopkins University Press, 1987, pp. 174-203. This lengthy analysis of Webb's administrative practices furnishes a biographical perspective on the way he managed NASA during the Apollo years. It discusses his triadic division of labor among the three top managers—himself, his deputy Hugh L. Dryden, and Associate Administrator Robert C. Seamans, Jr.; Webb's political astuteness; his struggles with the Air Force; his management during the Apollo 204 fire; and his attempts to "sell" post-Apollo programs in the post-fire political environment.
- Levine, Arnold S. *Managing NASA in the Apollo Era*. Washington, DC: NASA SP-4102, 1982. A narrative account of NASA from its origins through 1969, this book analyzes key administrative decisions, contracting, personnel, the budgetary process, headquarters organization, relations with the Department of Defense, and long-range planning.
- Logsdon, John M. "Selecting the Way to the Moon: The Choice of the Lunar Orbital Rendezvous Mode." *Aerospace Historian*. 18 (Summer, 1971): 63-70. In this well-written article, Logsdon heralds the landing on the Moon as "one of the greatest technological accomplishments of western civilization" and points to the selection of the lunar orbital rendezvous (LOR) as one of the key decisions in successfully carrying out the Apollo mission. He shows that while few NASA managers were initially convinced of the merits of this approach, a few individuals within NASA convinced the remaining leaders in the space agency to support this approach, resulting in "one of the most important choices in the history of technology."
- Low, George M. *The Apollo Program: A Midstream Appraisal*. Washington, DC: Smithsonian Institution Press, 1966. Edwin A. Link Lecture Series, Smithsonian Publication no. 4693. This 22-page reprint of a lecture by the deputy director of the Manned Spacecraft Center assesses the Apollo program from a management perspective at a time when even Gemini was incomplete. He devotes considerable attention to astronaut training and the problems of flight control. Useful for a sense of where the program was almost 5 years after President Kennedy's proclamation of the intent to land an American on the Moon and more than three years before the actual landing.
- McCurdy, Howard E. *Inside NASA: High Technology and Organizational Change in the U.S. Space Program*. Baltimore, MD: Johns Hopkins University Press, New Series in NASA History, 1993. While not devoted exclusively to the Apollo period, this study of NASA's organizational culture over the course of its entire history includes coverage of that culture during the Apollo period. Based on archival sources and extensive interviews, McCurdy covers such topics as the Apollo fire, Apollo 13, the lunar orbit rendezvous, approaches to contracting, the relationships between NASA's centers and the headquarters, and much else. He attributes NASA's relative success during the Apollo period to a number of factors including extensive testing, technical capabilities maintained within the agency, and a willingness to accept risk and failure. Then he shows how with age, the agency's performance tended to decline. An important and provocative study with which, naturally, not everyone will agree.
- Mueller, George E. "Apollo Actions in Preparation for the Next Manned Flight." *Astronautics and Aeronautics*. 5 (August 1967): 28-33. Reviews the program from materials to management, comments on the Apollo 204 fire and the changes made in response to it, and states that an open-ended 1968 mission will be a major milestone in the program.
- National Aeronautics and Space Administration. *What Made Apollo a Success?* Washington, DC: NASA SP-287, 1971. Reprint of eight articles from *Astronautics and Aeronautics*, March 1970, by such key Apollo

program managers as George M. Low, Kenneth S. Kleinknecht, Eugene F. Kranz, and Howard W. Tindall, Jr. Discusses topics ranging from design principles to mission planning.

Perrow, Charles. *Complex Organizations*. New York: Random House, 1979. A general study, this work investigates the management of sophisticated organizations such as NASA and offers some general insights into the way in which the Shuttle program was handled.

Roberts, Christopher B. "NASA and the Loss of Space Policy Leadership." *Technology in Society*. 12 (1990): 139-55. As the title suggests, this article discusses NASA's inability since Apollo to obtain adequate funding for programs it wants to pursue. The author argues that the reason for this failure lie in the "dominance of bureaucratic goals over program goals." While not specifically focused on Apollo, this discussion does cover the reasons for its success as background for the succeeding failures.

Roland, Alex. "Barnstorming in Space: The Rise and Fall of the Romantic Era of Spaceflight, 1957-1986." In Byerly, Radford, Jr. Editor. *Space Policy Reconsidered*. Boulder, CO: Westview Press, 1989. Pp. 33-52. This interesting article says little directly about Apollo but argues that its success led NASA to develop a long-range plan in 1969 that it continued to follow for the next two decades. "Believing that only manned spaceflight sells before Congress and the public, [NASA, he argues] has never given proper exposure to its unmanned programs. NASA's truly spectacular achievements in space science, earth resources monitoring, geodesy, and weather analysis have gone comparatively unnoticed." Roland believes that NASA should invest its limited budgets since Apollo in less expensive but more productive automated missions instead of ones carrying humans. Not everyone will agree with this assessment, but it represents one knowledgeable scholars perception of the effect of Apollo on NASA management.

Seamans, Robert C., Jr. "The National Commitment to Apollo." *Astronautics and Aeronautics*. 7 (August 1969): 32-48. The former deputy administrator of NASA presents an insider's view of the history of the Apollo program dating back to the Eisenhower administration and discusses how its architects got the program started and its managers carried out its goals. He concludes that management needed continually to monitor the program's elements, formulate alternate plans when difficulties arose, ensure good vertical communication in both directions, remain flexible, and retain capable, dedicated people for "both making and executing decisions." Discusses the "Apollo Effect," which inspired national debates on the efficacy of such an approach to achieving other national goals.

\_\_\_\_\_. "Action and Reaction: Part 2, Lessons Learned." *Astronautics and Aeronautics*. 7 (September 1969): 44-52. Although bearing a different title, this is part 2 of the article above in which the author draws management lessons from the Apollo program in the areas of allocating resources, managing actions, dealing with overlapping authority, competition in space, and cooperation.

\_\_\_\_\_. "Action and Reaction—Conclusion: The Space Program and the Needs of the Nation." *Astronautics and Aeronautics*. 7 (October 1969): 62-75. The conclusion of the three-part article, this segment proposes national priorities for research and development, then measures the space program against them.

Seamans, Robert C., Jr., and Ordway, Frederick I., III. "Lessons of Apollo for Large-Scale Technology." In Durant, Frederick C., III. Editor. *Between Sputnik and the Shuttle: New Perspectives on American Astronautics*. AAS History Series, 3. San Diego: Univelt, 1981. Pp. 241-87. This article by the former deputy administrator of NASA during most of the Apollo period and a knowledgeable writer on space subjects first appeared in *Interdisciplinary Science Reviews* (London) in late 1977. It discussed the Apollo program in terms of its "object lesson[s] for the management of large-scale technological endeavors." Among the lessons the two authors derived from NASA's impressive achievements in the program as well as its problems such as the Apollo 204 fire were that without support and "a solid use of relevant technology" no large-scale program could succeed. Also crucial was the need to offer benefits to significant numbers

of people, whether those benefits were tangible or intangible, such as national security or pride. Finally, Apollo and its successor, Skylab, showed that triumphs in one venture did not necessarily translate into support for future ventures, as NASA found out when funding shrank in the late 1960s and the 1970s in the wake of other national commitments.

Stuhlinger, Ernst, and Ordway, Frederick I., III. *Wernher von Braun: Crusader for Space*. Issued in two separate, unnumbered volumes: *An Illustrated Memoir* and *A Biographical Memoir*. Malabar, FL: Krieger Publishing Company, 1994. The illustrated volume consists of 132 pages of photographs and plates plus a biographical sketch and some appendices on von Braun's awards and honors, honorary degrees, lectures, and selected works. The much longer biographical memoir covers his life, with one chapter on Apollo, presented from the perspective of the authors, who were both co-workers under von Braun, Stuhlinger having worked under the German rocket developer and manager from 1943 to 1970 and Ordway from the mid-1950s to the mid-1960s. Contains a list of references but no specific reference notes, in character with its billing as a memoir rather than a critical, scholarly study. Provides a number of insights into von Braun's inimitable management style.

Tompkins, Phillip K. *Organizational Communication Imperatives: Lessons of the Space Program*. Los Angeles: Roxbury Publishing Company, 1993. Although sloppily written in places, this useful study examines the leadership and management at the Marshall Space Flight Center going back to the Apollo period. It discusses Wernher von Braun's authoritarian but effective leadership style and carries the analysis forward through the Shuttle Challenger accident in 1986 and the changes that followed.

Turner, Sarah H. "Maxime Faget and the Space Shuttle." *NASA Activities*. (November/December 1990): 22. This brief biographical sketch of the designer of the Mercury, Gemini, and Apollo spacecraft also covers his involvement in Shuttle design. Not specifically concerned with management matters, this article is nevertheless useful in providing a context for the understanding of Apollo management decisions.

\_\_\_\_\_. "Sam Phillips: One who Led us to the Moon." *NASA Activities*. (May/June 1990): 18-19. This biographical sketch of the Air Force general from the Minuteman program who became deputy director and then director of the Apollo program provides more of an overview of his life than an assessment of his managerial contributions to Apollo, but it does offer some perspectives to use in conjunction with true management studies.

United States Congress. House Committee on Science and Aeronautics. *Apollo Program Management: Staff Study for the Subcommittee on NASA Oversight of the Committee on Science and Aeronautics, U.S. House of Representatives, Ninety-first Congress, First Session*. Washington, DC: Government Printing Office, 1969. Less the study indicated in its title than a collection of summaries of presentations made to the Subcommittee on NASA Oversight by five key NASA contractors and the three principal NASA centers involved in the Apollo program—the Kennedy Space Center, the Manned Spacecraft Center in Houston, and the Marshall Space Flight Center—this is nevertheless a highly useful compilation if hardly a critical one. It includes appendices containing correspondence with industrial managers and Manned Space Flight Center directors plus a bibliography of key Apollo documents and program directives. As such, this volume provides a good deal of insight into the ways in which Apollo program management operated, although obviously other sources need to be consulted as well.

United States Congress. House Committee on Science and Aeronautics. *NASA Lunar Orbit Rendezvous Decision. Hearing, Eighty-seventh Congress, Second Session, July 12, 1962*. Washington, DC: Government Printing Office, 1962. This 11-page committee print contains primarily a briefing by D. Brainerd Holmes, director of the Office of Manned Space Flight, to Congress on the decision to employ a lunar orbit rendezvous rather than an Earth orbit rendezvous as the mode for reaching the Moon. Also included are comments by Clyde Bothmer and Joseph F. Shea plus answers to queries by congressmen.

United States Congress. House Committee on Science and Aeronautics. *Pacing Systems of the Apollo Program: Staff Study for the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, U.S. House of Representatives*. Washington, DC: Government Printing Office, 1965. This committee print analyzed the lunar excursion module and the command and service modules plus their critical subsystems. It concluded that NASA management was "employing its resources effectively in" solving problems with these pacing systems. The analysis itself comprises only 9 pages of the print, the remainder consisting of testimony by NASA officials under questioning by subcommittee members. Includes 44 figures illustrating the points made by NASA managers.

Webb, James E. *Space Age Management: The Large-Scale Approach*. New York: McGraw-Hill, 1969. This book is an attempt by the second NASA administrator, who presided over the agency during most of the Apollo era, to distill what he learned from this experience for use in other large-scale efforts. He discusses such issues as doctrines and practices, the environment in large-scale endeavors, how to safeguard the democratic process in such efforts, the impact on society, leadership as a factor, organizational structure, and the executive at work.



*A photo of one of the Apollo 11 astronauts' foot on lunar soil. NASA photo 69-H-1259.*

## CHAPTER 10

# JUVENILE LITERATURE

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- Alexander, Thomas W. *Project Apollo: Man to the Moon*. With a Foreword by Sir Bernard Lovell. Illus. by Tom Turner. New York: Harper & Row, 1964. This book describes the early history of Apollo for high school level students.
- Barrett, Norman S. *The Moon*. New York: Franklin Watts, 1985. This short picture book for juveniles offers a description of the Moon's physical characteristics as they emerged from data provided by the Apollo missions.
- Bay, Timothy. *First to the Moon*. New York: CPI Group, 1993. A discussion for younger readers of the first flight to the Moon, the significance of the space program, and the successes and tragedies that have occurred in space.
- Becklake, John. *Man and the Moon*. Morristown, NJ: Silver Burdett Co., 1981. Also published in Spanish as *El Hombre y la Luna*. Translated by Victor Pozanco. Barcelona, Spain: Editorial Juventud, 1987. A discussion for juveniles of the Moon's physical makeup, its orbit, and of humankind's fascination with this heavenly body. Includes information on Project Apollo but is not devoted exclusively to that topic.
- Branley, Franklyn Mansfield. *Man in Space to the Moon*. New York: Crowell, 1970. A juvenile history written for grades 5-8.
- Charleston, Gordon. *Armstrong Lands on the Moon*. New York: Dillon Press, 1994. A still forthcoming account for a juvenile audience by the author of *Perry Reaches the North Pole*.
- Chester, Michael. *Let's Go to the Moon*. New York: Putnam, [1974], revised edition. This little book for children pictures the reader as the captain of a spaceship to the Moon. A Moon rover on the surface collects samples. Then the story carries the reader back to the orbiting spaceship and thence to Earth.
- Collins, Jim. *First to the Moon*. New York: C.P.I., 1978. Not just about Apollo, this book for juveniles covers numerous firsts in space exploration. Also included is a chapter on the Moon's influence on writers from Shakespeare to Al Capp.
- Coombs, Charles I. *Project Apollo: Mission to the Moon*. New York: Morrow, 1965. A 96-page illustrated history written for juveniles in grades 5-9.
- Darling, David J. *The Moon: A Spaceflight Away*. Minneapolis, MN: Dillon Press, 1984. This book for juveniles discusses the evolution of knowledge about the Moon beginning with the invention of the telescope and carrying the story forward through the Apollo missions and what they revealed.
- Donnelly, Judy. *Moonwalk: The Story of the First Trip to the Moon*. New York: Random House, 1989. This book for youngsters covers the preparations and activities that culminated in the initial lunar landing of Apollo 11 in July 1969.
- Dwiggins, Don. *Eagle Has Landed: The Story of Lunar Exploration*. San Carlos, CA: Golden Gate Junior Books, 1970. This 80-page volume for youngsters covers the history of lunar science, the first landing on the Moon, and future possibilities for lunar studies.

Fradin, Dennis B. *Moon Flights*. Chicago: Childrens Press, 1985. This book for juveniles discusses the first landing on the Moon and the later Apollo missions. It then assesses their importance for our exploration of space.

Fraser, Mary Ann. *One Giant Leap*. New York: Henry Holt, 1993. Another book for juveniles that provides a blow-by-blow discussion of the first flight to the Moon, leading to Neil Armstrong's famous statement evoked in the title.

\_\_\_\_\_. *The True Book of the Moonwalk Adventure*. Chicago: Childrens Press, 1970. A 46-page illustrated book written for grades 1-4.

Fuchs, Erich. *Journey to the Moon*. New York: Delacorte Press, 1969. This is a children's history of Project Apollo from its inception until the completion of the Apollo 11 mission. It is heavily illustrated and has a spare text. It is designed for 4-7 year olds, and uses double-page, full-color illustrations. This is the American edition of an English translation of *Hier Apollo 11*. München: Ellermann, 1969. The English edition is entitled *Moonwalk: the Story of Apollo 11*. London: Abelard-Schuman, [1969].

Furniss, Tim. *The First Men on the Moon*. New York: Bookwright Press, 1989. This little book for juveniles covers the development of the Apollo spacecraft that carried humans to the Moon in 1969.

Gold, Susan Dudley. *Countdown to the Moon*. New York: Crestwood House, Maxwell Macmillan International, 1992. This juvenile book discusses the origins, development, and achievement of America's goal to land humans on the Moon and return them safely to Earth.

Gurney, Gene. *Americans to the Moon: The Story of Project Apollo*. New York: Random House, 1970. This is a 147-page "Landmark Giant" book for grades 5-9.

Haggerty, James J. *Apollo: Lunar Landing*. Chicago: Rand MacNally, 1969. This is a children's story of the Apollo flights. It has been illustrated with striking Apollo photographs, many of them in color.

Hendrickson, Walter B. *Apollo 11: Men to the Moon*. Irvington-on-Hudson, NY: Harvey House, 1970. A 46-page illustrated history written for grades 2-5, this little book provides a description of the lunar landing site and discusses flight preparation and the actual voyage to the Moon on Apollo 11 spacecraft.

Hill, Robert White. *What the Moon Astronauts Do*. New York: John Day Co., 1971. This short, 64-page, heavily-illustrated book is written for grades 3 and up.

Holder, William G. *Saturn V: The Moon Rocket*. New York: J. Messner, 1970. This 192-page book for juveniles discusses the design, development, and testing of the Saturn V launch vehicle that boosted the various Apollo spacecraft to the Moon.

Kennedy, Gregory P. *Apollo to the Moon*. New York: Chelsea House Publishers, 1992. Introduction by Michael Collins. Rather longer than most juvenile books, this one provides a fairly detailed overview of Project Apollo.

*Man in Space*. Garden City, NY: Doubleday, 1969. This piece of juvenile literature provides brief coverage of the Mercury, Gemini, and Apollo programs with diagrams illustrating flights and equipment.

Martin, Bill, Jr. *The Eagle has Landed*. Paintings by Frank Aloise. New York: Holt, Rinehart and Winston, 1970. A Bill Martin instant reader containing a chronological account of the Apollo 11 trip to and from the Moon written for a juvenile audience.

- Muirden, James. *Going to the Moon*. New York: Random House, 1987. This child's book for ages 4-6 discusses in simple terms the Apollo 11 mission to the Moon.
- Paige, David. *Moving a Rocket, a Sub, and London Bridge*. Chicago: Childrens Press, 1981. This 42-page book for children discusses the procedures and special equipment used for moving the London Bridge, a German submarine from World War II, and the Saturn rocket.
- Richey, B.J. *Apollo Astronauts: First Men to the Moon*. Huntsville, AL: Strode Publishers, 1970. More sophisticated than most juvenile literature, this 144-page, illustrated book was written for high school level students. It covers Apollo 8 through Apollo 11 and includes biographies of the astronauts.
- Simon, Tony. *The Moon Explorers*. New York: Four Winds Press, 1970. A simple book for grades 3-7.
- Stein, R. Conrad. *Apollo 11*. Chicago: Childrens Press, 1992. This recent addition to juvenile literature discusses the whole series of Apollo spaceflights but puts special emphasis on Apollo 11 since it achieved the first lunar landing.
- Vogt, Gregory. *Apollo and the Moon Landing*. Brookfield, CT: Millbrook Press, c. 1991. This juvenile book covers the full history of the Apollo program. Complete with bibliography and index.
- We Came in Peace*. San Rafael, CA: Classic Press, 1969. This piece of juvenile literature goes over the history of space exploration, summarizes the trips to the Moon during Apollo to date, and then discusses the possible future of spaceflight.
- Westman, Paul. *Neil Armstrong, Space Pioneer*. Minneapolis, MN: Lerner Pub. Co., 1980. A biography for juveniles of the first human to set foot on the lunar surface.
- Wheat, Janis Knudsen. *Let's Go to the Moon*. Washington: National Geographic Society, 1977. Another juvenile book, this one highlighting the Apollo 17 mission.
- Worden, Alfred Merrill. *I Want to Know about a Flight to the Moon*. Garden City, NY: Doubleday, 1974. This juvenile book by an Apollo 15 astronaut describes his becoming an astronaut, his training, and the mission on which he flew.



*Apollo Mission Control Center in Houston during Apollo 11. NASA Manned Spacecraft Center photo S-69-39593.*

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